NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

DEVELOPMENT OF A MODEL TO PREDICT DRUG USE AT THE LOCAL COMMAND LEVEL IN THE U.S. NAVY

by

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March, 1997

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE March 1997	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE DEVELOPMENT OF A MODEL TO PREDICT DRUG USE AT THE LOCAL COMMAND LEVEL IN THE U.S. NAVY/UNCLASSIFIED	5. FUNDING NUMBERS
6. AUTHOR(S) LT Stuart C. Satterwhite	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.	
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	12b. DISTRIBUTION CODE

13. ABSTRACT (maximum 200 words)

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The results show that a model can be developed to predict drug use at the local command level based on the underlying civilian drug use propensity. The sex of an individual is the most important predictor for civilians. The education level and the age of the individual are the most important predictors for the military. Race and sex do not have an impact on drug use among military members.

The model could be used by local commanders to determine the potential threat of drug use at the command. Commands should test at a monthly test rate relative to the magnitude of this threat. The model should be revalidated periodically as demographic and locational factors change.

14. SUBJECT TERMS Manpower Analysis, Prediction of Drug Use, Demographic Modeling	15. NUMBER OF PAGES 124
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1997

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ACKNOWLEDGMENTS

First, I would like to thank God for giving me the opportunity to accomplish this goal. Second, I would like to thank my wife Michelle and my daughter Ashley for their continued unselfish support throughout this time. Finally, I would like to thank my advisors, Dr. Borack and Dr. Mehay for their steadfast guidance throughout this thesis. All of you made this possible.

I. INTRODUCTION

A. BACKGROUND

The issue of drug use has become a hot topic recently. It became an issue in the 1996 Presidential elections when the results of the 1995 National Household Survey on Drug Abuse (NHSDA) showed drug use among teenagers rising dramatically. The rate of drug use more than doubled from 1992 to 1995 according to the reports. Drug use went from 5.3 percent monthly in 1992 to 10.9 percent monthly in 1995 for teenagers age 12 - 17, over a 105 percent increase. Cocaine use for the same time period and age group also increased from 0.3 percent to 0.8 percent, over a 166 percent increase. Marijuana use went from 3.4 percent to 8.2 percent, over a 140 percent increase. These increases followed a decade of declining drug use rates(Gordon, 1996).

The Navy is concerned with the amount of drug use among its personnel because of the importance and inherently dangerous nature of its work. Drug abuse increases the risk of unintentional injuries, accidents and deaths, not only among those who use drugs, but also among their co-workers and shipmates. Because of these negative effects, the Department of Defense has initiated a comprehensive policy to deal with drug abuse(Bray, 1992).

Current Navy policy toward drug use is zero tolerance, regardless of rank or rate. Any drug use is considered abuse and if detected is grounds for immediate discharge. The current Navy policy is for each command to test between 10 percent and 30 percent monthly(OPNAV 5350.4B, 1990). By conducting drug testing, the Navy deters potential users and detects actual users. The Navy also incurs a cost of performing all of these tests. The possibility exists that the Navy could lower the cost of its drug testing program by reducing the frequency of testing in commands where the threat of drug use is low or minimal. It is therefore important to be able to predict differences in potential drug use across Navy commands.

B. OBJECTIVES

The objective of this research is to develop methods for predicting drug use in the United States Navy. Several different data sets will be used for this project. Among these are the 1994 National Household Survey on Drug Abuse (U.S. Department of Health and Human Services), the 1995 Department of Defense Survey of Health Related Behaviors Among Military Personnel (DODWWS), and the 1994 and 1995 Enlisted and Officer Master files for Navy personnel obtained from the Defense Manpower Data Center (West).

C. THE RESEARCH QUESTION

The primary research question is: Can a model be developed that predicts potential drug use among personnel at specific local Navy commands? Additional questions include: Can demographic characteristics be used to predict potential drug users? Can the characteristics of civilian drug users be applied to the population of military personnel? Can drug use predictors be developed for specific geographic locations?

D. SCOPE AND LIMITATIONS

The thrust of this thesis is to develop a model for local commanders to use to predict drug use among personnel in their command. The model was developed from the characteristics of self-reported drug users in the NHSDA and the DODWWS surveys.

The limitations encountered during the research did not allow the inclusion of specific geographic regions in the model. The NHSDA provides information only on nine broad geographic divisions, while the DODWWS can only be broken down into three geographic groupings. The nine NHSDA divisions are: New England - Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; Middle Atlantic - New Jersey, New York, Pennsylvania; East

North Central - Illinois, Indiana, Michigan, Ohio, Wisconsin; West North Central - Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota; South Atlantic - Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia; East South Central - Alabama, Kentucky, Mississippi, Tennessee; West South Central - Arkansas, Louisiana, Oklahoma, Texas; Mountain - Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming; Pacific - Alaska, California, Hawaii, Oregon, Washington(Codebook, 1996). The three geographic groupings for the DODWWS were: CONUS - Navy personnel stationed in the United States; CONUS(afloat) - Navy personnel stationed in the United States, however they were attached to a ship that could deploy; and OCONUS - Navy personnel who were stationed out of the United States. Another limitation with both the NHSDA and the DODWWS is, they are self-reported data. Their validity is only as good as the honesty of the respondents. The NHSDA is geared toward the civilian population. It intentionally omits military personnel from its sample of respondents. This causes its estimates of drug use to be higher for the civilian sector then the military population because little drug testing is conducted in the civilian

sector. The DODWWS only samples military personnel; its results may underestimate drug use rates because of the inherent threat of drug testing and subsequent dismissal.

E. METHODOLOGY

A multivariate model was specified from the variables available in the NHSDA civilian data and a multivariate model was developed from the variables in the DODWWS military data. The models were specified using the demographic characteristics of the survey respondents. The models were estimated using non-linear maximum likelihood techniques used for logistic regression(Kleinbaum, 1994). Actual data were collected from local commands and included demographic characteristics of the members of each command. The estimated logit model was then used to predict the drug use probabilities (or proportions) at the local command level depending on the known makeup of the command.

F. ORGANIZATION OF STUDY

Chapter II of this study reviews the history of the Navy's drug testing program. It examines the policies governing the program. It also reviews the NHSDA and DODWWS surveys, and discusses their strengths and weaknesses. Chapter III describes the methodology of the study. The estimates of the logit models are discussed as well as

validation procedures. Logit models are estimated from both the NHSDA and the DODWWS. Chapter IV discusses the characteristics of the local commands used in the study. It also includes predictions for those commands. Chapter V summarizes the results of this thesis. It also presents the recommendations for further research in this area.

II. BACKGROUND AND LITERATURE REVIEW

A. HISTORY OF THE NAVY'S DRUG PROGRAM

The concept of drug testing can be traced back many years. According to Clifton Bryant, "Alcohol and drugs are often inextricably bound up in military custom and existence(Bryant, 1979)." The difference between drugs and alcohol is that alcohol is legal while drugs are considered contraband.

> Concerns about substance use attract negative sanctions when combat readiness is threatened or when public attention is focused on behavior that might endanger lives or threaten defense capabilities. Events during the late 1970s, such as the plane crash on the aircraft carrier *Enterprise*, alerted Congress and the American people to the likelihood that a drug problem existed in the military as well as in civilian life. The military services responded by attempting to identify and correct the problem(Ballweg, 1991).

A DoD task force was convened in 1967 to investigate drug use in the military. This study led to a policy formulation in 1970(Bray, 1992). President Nixon felt that drug users could be identified through drug testing and then be rehabilitated. The use of random urinalysis would allow the users to be identified, rehabilitated, and then returned to full duty. The testing at this time was not intended to

be used for punitive actions. The hope was that users would come forward in search of help so they could be rehabilitated.

It was determined in 1974, by researchers at the Human Resources Research Organization, that there were large differences between the number of people surveyed who anonymously said they used drugs and the number indicated by the urinalysis program. It was also determined that the drug testing was not acting as a deterrent to the people who desired to use drugs(Reaser, 1975). But, by 1974 the results of drug tests were being used in Uniformed Code of Military Justice actions.

A Military Court of Appeals decided in 1974 that the urinalysis program could not be used for disciplinary or administrative action. This, in effect, virtually nullified the deterrence effect of the program, because detected personnel could only be referred to a rehabilitation center. In 1980, the Military Court of Appeals reversed its decision and set the stage for the current policy.

The Department of Defense also issued drug testing guidelines in 1980. It issued DoD Directive 1010.1 which set the stage for random urinalysis. The policy for urinalysis testing is as follows:

> It is DoD policy to use the drug abuse testing program to 1)preserve the health of members of the Military Services by identifying drug abusers in order to provide appropriate counseling, rehabilitation, or other medical treatment; and 2)permit commanders to assess the security, military fitness, and good order and discipline of their commands, and to take appropriate action based upon such an assessment(DoD 1010.1, 1980)

This policy still allowed for the rehabilitation of individuals whom commanding officers deemed worthy. A second directive, DoD Directive 1010.4, made it illegal to possess, traffic or sell drugs. It also allowed personnel to be denied entry into the service because of drug dependence. It also set the policy that training would be required to help prevent drug abuse and to rehabilitate as many as possible(DoD 1010.4, 1980).

In 1981, the Navy adopted the policy of zero tolerance. This policy was not as harsh and unforgiving as one might assume. The policy was initially aimed at Officers and Chief Petty Officers who were to be automatically processed for discharge if they tested positive. A drug user who was in the ranks of E-1 through E-6 would be considered for his worthiness. If deemed treatable, then the individual would be offered rehabilitation. The individual would receive some disciplinary action, but would be returned to full

active duty upon successful completion of a rehabilitation program. This double standard would not last, however.

In September 1990, the policy of zero tolerance was applied to all members of the Navy. This meant that any member caught using drugs would be administratively processed upon completion of disciplinary action. The policy was further focused by the Chief of Naval Operations in 1990. Commanders were then directed to test their commands between 10 percent and 20 percent monthly(OPNAV 5350.4B, 1990). Today, they are permitted to test up to 30 percent of the command monthly, without special authorization(Policy Memo, 1996). This meant that the guidelines for testing had some flexibility, but that the Navy would still retain some consistency throughout the fleet by setting a minimum and maximum testing requirement. Specific guidelines are given as to when drug testing can occur. There are four times when mandatory urinalysis can occur:

1. Inspection. During inspections performed under Military Rule of Evidence 313.

2. Search and Seizure. During a search or seizure action.

3. As part of one of the following examinations:

(a) A command-directed examination or referral of a specific member to determine the member's competency for duty and need for counseling, rehabilitation, or other medical treatment when there is a reasonable suspicion of drug abuse.

(b) An examination in conjunction with a service member's participation in a DoD drug treatment or rehabilitation program.

(c) An examination regarding a mishap or safety investigation undertaken for the purpose of accident analysis and development of countermeasures.

4. Any other examination ordered by medical personnel for valid medical purpose under Military Rules of Evidence 312(f) including emergency medical treatment, periodic physical examinations, and such other medical examinations as are necessary for diagnostic or treatment purposes(OPNAV 5350.4B, 1990).

The purpose of the Navy's drug testing program is fourfold. First, it establishes a means for assessing a command's readiness. Second, it deters drug use. Third, it is a means for monitoring personnel in rehabilitation programs. Fourth, it is a way for the Navy to track statistical data on drug use and demographic characteristics associated with drug use(OPNAV 5350.4B, 1990). To prevent drug use among military personnel, the military tests applicants for drugs and conducts background investigations on these individuals. The military also conducts periodic

urinalysis to test for use while on active duty, although each service varies in the manner and frequency they test.

All Navy personnel are subject to random urinalysis at any time. The decrease in the proportion of members testing positive has decreased from 7 percent in 1983 to less than 1 percent in recent years(Borack, 1996). This decrease leads many to consider the program a success. This success is especially good news when one considers the costs of drug usage; readiness impacted, health problems, on the job accidents and other.

B. NATIONAL HOUSEHOLD SURVEY ON DRUG ABUSE (NHSDA)

The National Household Survey on Drug Abuse (NHSDA) is a study designed to measure drug use in the U.S. civilian population and trends in usage over time. It began in 1971 under the auspices of the National Commission on Marihuana and Drug Abuse(Main Findings, 1996). Today, the Office of Applied Studies within the Substance Abuse and Mental Health Services Administration oversees the study. The Substance Abuse and Mental Health Services Administration is a branch of the U.S. Department of Health and Human Services. The survey has been kept consistent to allow for the analysis of trends. It has also allowed for certain topics to be analyzed in depth.

The 1979 and 1982 surveys obtained detailed information about the use of heroin. Cocaine was the focus in the 1985 survey. The 1994-B survey contained many questions on mental health, health care and drug testing in the workplace. To increase reliability certain population groups are oversampled. For instance, Hispanics and blacks have been oversampled since 1985, as have people under 35. People in rural areas have been oversampled in the 1979 and 1994 surveys, while people in certain metropolitan areas that were oversampled are no longer oversampled. People that smoke have been oversampled because of the high correlation between smoking and illegal drug use. Oversampling these groups permits more accurate estimates of drug use among these groups and provides greater accuracy for studies of group differences(Main Findings, 1996).

The NHSDA samples people age 12 and older. Some people are intentionally omitted, however. These are people that are institutionalized, those that have no permanent residence, and active duty military. "The sample for the 1994 NHSDA was designed so that study results could be used to make inferences about the United States civilian, noninstitutionalized population age 12 and older(Main Findings, 1996)."

The sampling design of the study involved a multistage area sample consisting of 117 primary sampling units. A primary sampling unit was constructed of counties (administrative subdivisions of states) or metropolitan areas. A composite size measure was used to ensure the subgroups surveyed met specific constraints. These constraints were defined by age and minority group membership(Main Findings, 1996). The survey was administered by trained interviewers in the respondent's home. The survey results were not known to the administrator, however. Even though the surveys were administered by trained individuals, the results are only as good as the honesty of the people surveyed. The 1994 survey was split into two questionnaires. The 1994-A was completed by 4,372 people and was used to compare prevalence estimates in 1994 with those from previous years, while the 1994-B was completed by 17,809 people and contained a new 'core dataset' with improved editing procedures for estimating drug use. The survey asks respondents about drug use in the past 30 days, the past year, and ever(Main Findings, 1996).

The trend in any illegal drug use in the past 30 days has been decreasing for the most part since 1979. Figure 1 shows the relationship broken down into three age groups

based upon the 1994-A survey. The 12-17 year old group decreased in drug use from 18.5 percent in 1979 to 6.1 percent in 1992, then rose to 9.5 percent in 1994. The 18-25 year old group decreased in drug use from 37.4 percent in 1979 to 13.0 percent in 1992, then rose slightly to 13.2 percent in 1994. The 26 and older age group has consistently decreased its drug use from 6.6 percent in 1979 to 4.0 percent in 1994.

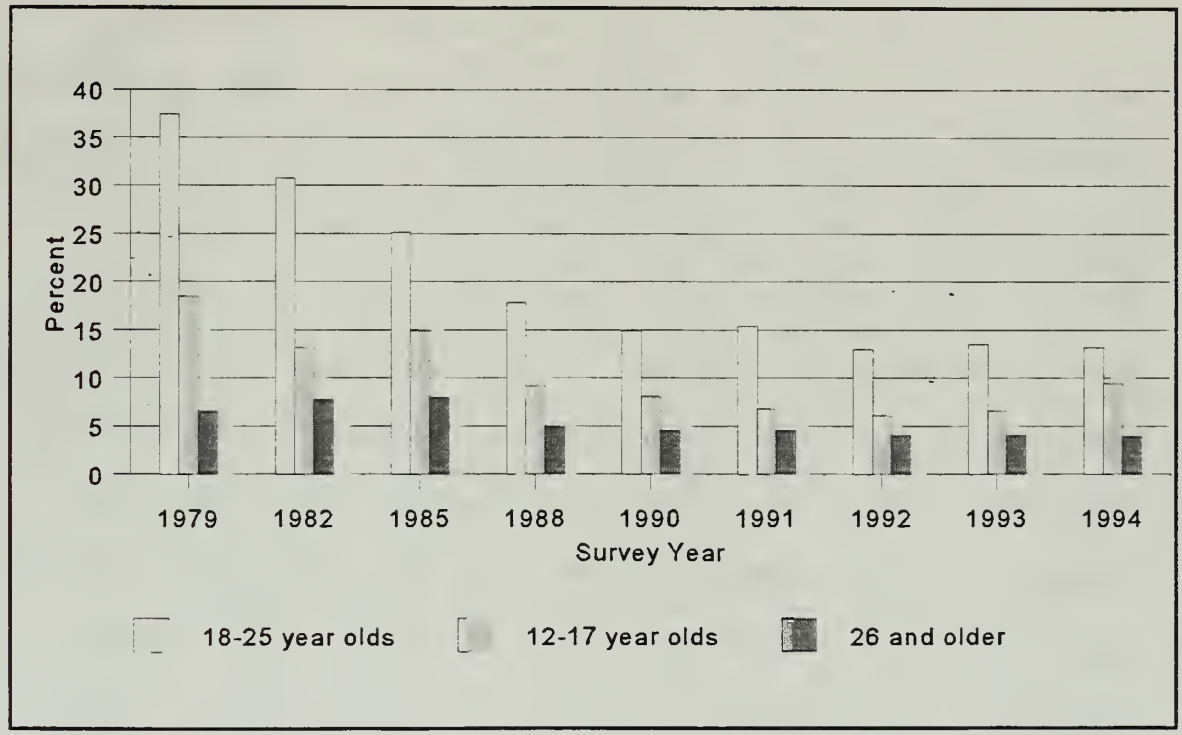

Figure 1 Trends in Civilian Drug Use, Past 30 Days
Source(Main Findings, 1996)

One of the strengths of the NHSDA is that it is the only study that examines the civilian population, ages 12 and older, for drug use. It does this consistently, and with a systematic approach that allows it to produce trend information. "In-person interviews with a large national probability sample seem to be the best way to estimate drug use in virtually the entire population of the United States(Main Findings, 1996)."

The survey also has its limitations. As mentioned earlier, the survey is self-reported data. Some people will undoubtedly provide information that is incorrect. A second limitation of the survey is that it is cross-sectional rather than longitudinal. The survey does not track the same respondents over time. The survey provides an accurate snapshot at the time the survey was taken, but it does not show what some of the underlying causes and changes are because the same people are not observed repeatedly (called panel data). A third limitation is that a small section of society is not sampled. Specifically, the military is a segment of society that is expected to have lower drug use rates. The total amount of society omitted from the NHSDA study is about 2 percent. These missing segments could possibly influence certain areas such as the prevalence of

heroin use because of the low frequency of reported use. Only 1 percent of the survey respondents reported ever using heroin, while 31 percent of the respondents reported ever using marijuana(Main Findings, 1996).

C. DEPARTMENT OF DEFENSE SURVEY OF HEALTH RELATED BEHAVIORS AMONG MILITARY PERSONNEL (DODWWS)

The Department of Defense Survey of Health Related Behaviors Among Military Personnel (DODWWS) began in 1980 under the supervision of the Assistant Secretary of Defense for Health Affairs. "The purpose of the surveys is to systematically obtain data that can be used to improve the understanding of the nature, causes, and consequences of drug and alcohol abuse and health in the military; evaluate drug and alcohol abuse and health programs and policies; determine the appropriateness of military emphasis placed on program elements; and examine the impact of current and future program policies(Bray, 1992)."

The DODWWS sampling method uses a two stage design. All active duty military are eligible to be included in the survey. Certain groups are not included in the sampling. These are "...recruits, service academy students, persons absent without official leave (AWOL), and persons who had a PCS at the time of data collection(Bray, 1995)." The first stage of the sampling procedure involves separating the

services and the geographic regions. After that, personnel are selected based upon pay grade. The intent was to have the sample be representative of the active duty force worldwide. The surveys were administered by trained civilian teams. If an individual did not show up for the administration session, then the survey was mailed to the individual with an explanation of the survey, the procedures, and the anonymity associated with the survey.

The use of illegal drugs by military personnel in the past 30 days has been decreasing since 1980, when it was at 27.6 percent. Figure 2 shows the downward trend for the entire military. Drug use has decreased to 19.0, 8.9, 4.8, 3.4, to 3.0 percent, respectively, in each of the subsequent survey years(Bray, 1995).

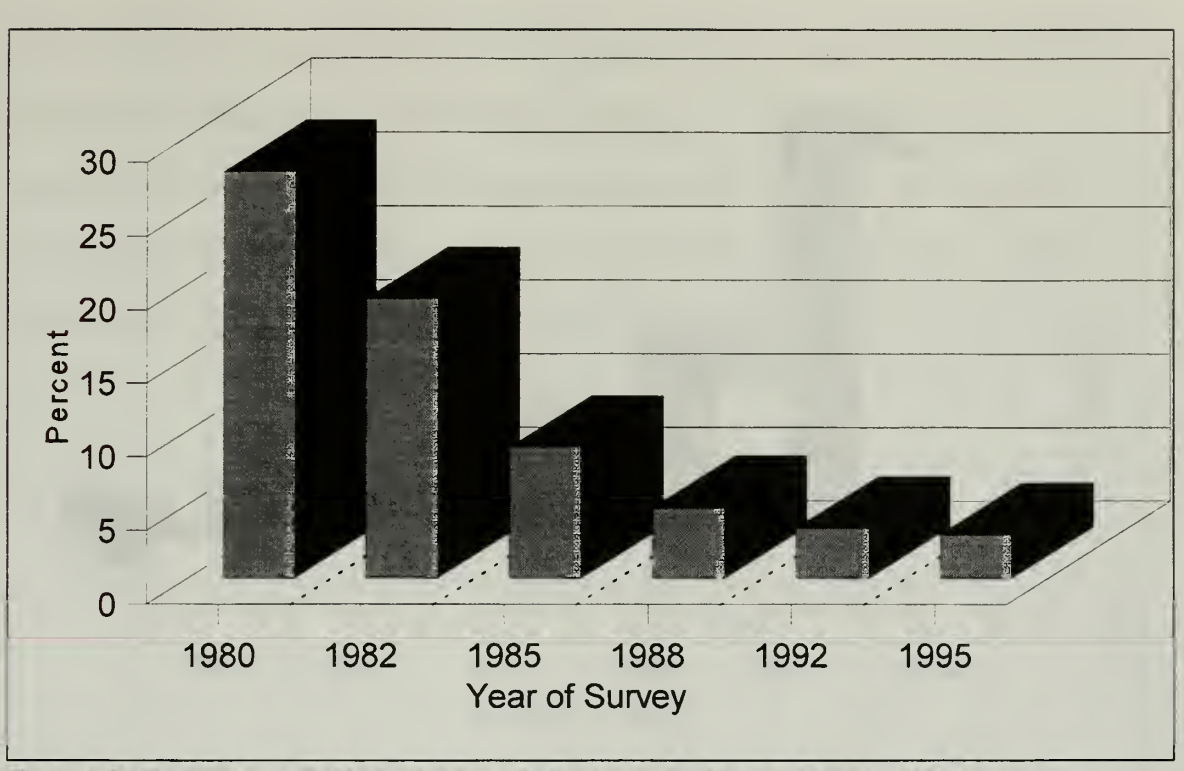

Figure 2 Trends in Military Substance Use, Past 30 Days
Source(Highlights, 1996)

In the Navy, substance use was at 33.7 percent in 1980. Figure 3 shows the downward trend for the Navy. Navy drug use has decreased to 16.2, 10.3, 5.4, 4.0, to 3.6 percent, respectively, in each of the subsequent survey years(Bray, 1995). Small wonder that the military was called the "Hollow Force" in the late 1970's and early 1980's. It seems clear that a major part of the large initial drop in drug use can be attributed to the implementation of urinalysis by the Navy.

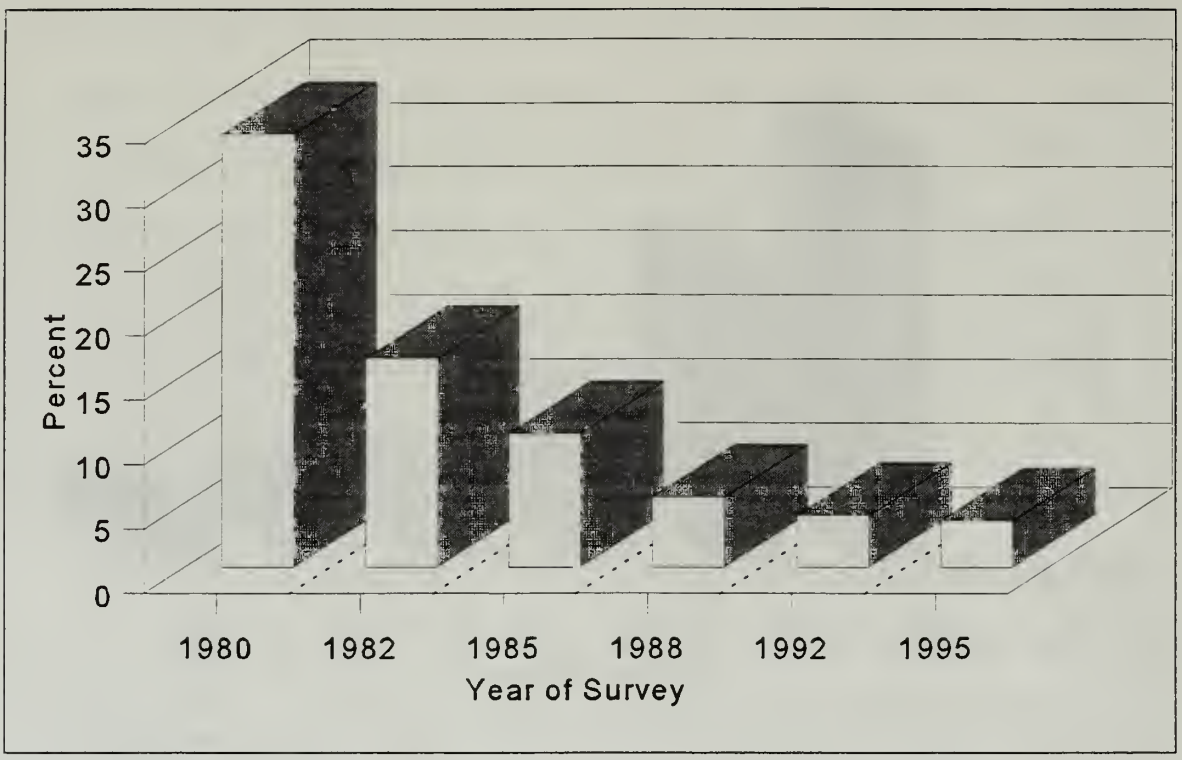

Figure 3 Trends in Navy Substance Use, Past 30 Days
Source(Highlights, 1996)

Drug use is consistently related to education, marital status, and pay grade. This is seen throughout the surveys. Personnel with less education are more likely to participate in drug use. Married personnel are less likely to use drugs than single individuals. Sex does not appear to have a significant impact on whether or not an individual would use drugs (although, in the 1992 survey men were twice as likely to use drugs then women)(Bray, 1995). White personnel were slightly more likely to use drugs then blacks or other races, at least since 1985. Hispanics have consistently had

the highest usage rate for any minority group since 1980, with the exception of 1985. Table 1 shows how the percentage of personnel using any drug (past 12 months) by demographic attributes (for the entire military). More detailed analysis of these variables will appear later.

Table 1 Drug Use Rates (in percent) Past 12 Months by Individual Attributes and Survey Years Source(Bray, 1995)

Characteristic	1980	1982	1985	1988	1992	1995
Male	36.0	26.5	13.5	9.0	6.7	6.7
Female	39.0	26.7	12.0	8.4	3.4	5.3
White	35.4	25.9	14.6	9.2	6.6	6.4
Black	41.5	29.0	10.0	7.8	4.2	6.3
Hispanic	44.9	29.5	11.9	9.5	8.9	7.6
Other	29.1	22.3	9.0	8.1	4.4	6.8
Less than HSDG	60.1	48.0	33.5	13.3	Note 1	Note 2
HSDG/GED	45.5	32.6	17.9	12.9	9.0	9.6
Some College	32.0	23.3	11.5	7.5	5.5	6.0
College Graduate	11.4	7.9	2.7	3.0	1.9	2.0
20 and younger	62.0	42.9	26.1	15.8	12.9	14.9
21-25	50.1	34.3	18.5	13.7	10.3	9.4
26-34	19.0	14.6	7.0	6.2	3.8	3.9
35 and older	3.7	2.9	1.6	2.2	1.9	2.1
Not Married	53.9	37.5	20.1	14.7	9.9	10.6
Married, spouse not present	34.7	24.0	13.8	12.4	7.1	7.6
Married, spouse present	19.4	14.7	7.3	4.4	3.6	3.5
E1-E3	59.0	41.3	22.2	17.7	15.5	14.3
E4-E6	38.8	26.1	14.1	9.1	5.3	5.8
E7-E9	4.0	3.1	2.1	1.8	1.9	1.5
W1-W4	3.6	5.1	1.0	1.5	1.2	1.0
O1-O3	9.4	5.6	2.3	2.0	1.2	2.0
O4-O10	2.0	1.6	1.2	1.2	1.3	1.0
Total DoD	36.7	26.6	13.4	8.9	6.2	6.5

Note 1 - No estimate due to large sampling error
Note 2 - Value combined into one HSDG or less value

The demographic composition of the military has changed over the years since the survey began. By standardizing the composition of the military to the demographic distribution of 1980, a similar downward trend still occurs. The standardization has the effect of making the service look demographically as if the people who were surveyed in 1995 were demographically similar to those at the time of the 1980 survey. This shows that the changes in the makeup of the military has not caused the decrease in drug use(Bray, 1995). The survey results show a steady decline in drug use since the survey began in 1980. Figure 4 shows the adjusted and unadjusted trends. Possibly, the implementation of the urinalysis program and the zero tolerance policy have had an impact on drug use in the Navy.

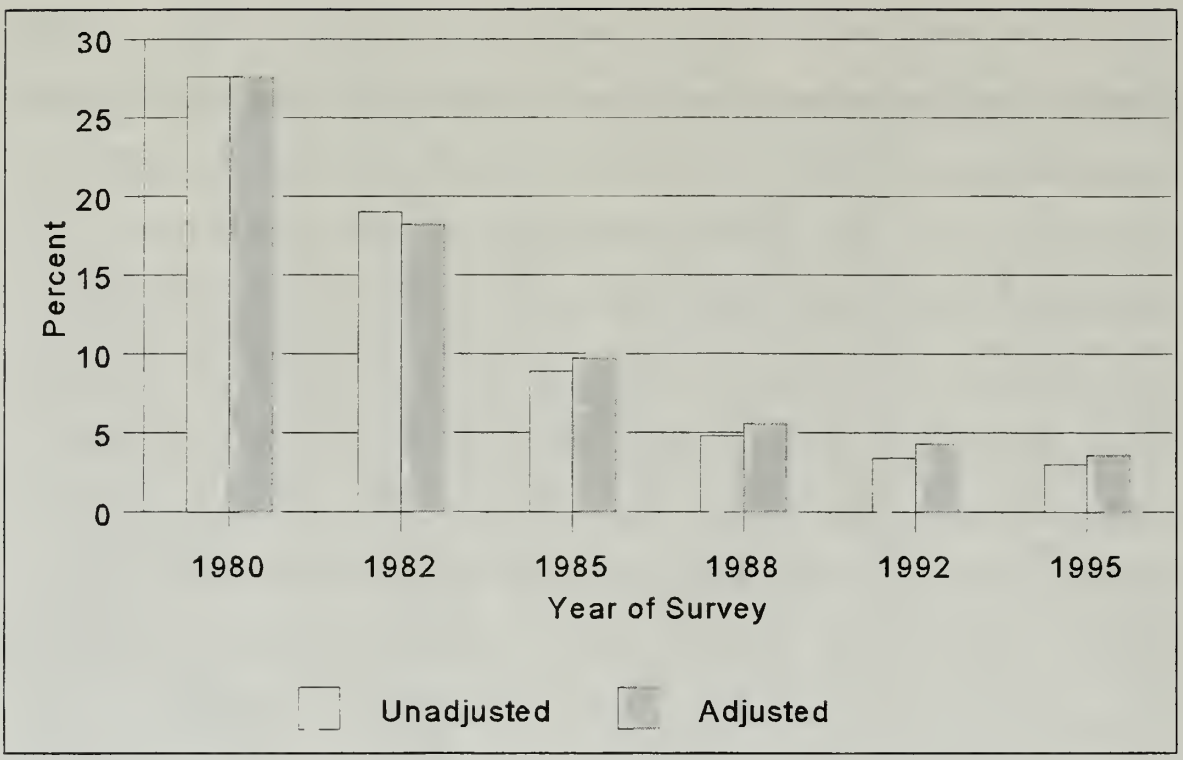

Figure 4 Trends in Military Substance Use, Past 30 Days - Adjusted and Unadjusted by Sociodemographic Characteristics Source(Highlights, 1996)

A strength of the DODWWS stems from the validation of its findings through urinalysis. The decline seen in the drug use rates in the DODWWS have also been seen in the urinalysis program(Main Findings, 1996). One of the limitations of the DODWWS was mentioned earlier; the issue of self-reported data. This issue has become more serious with the recent military personnel drawdown. The drawdown might keep personnel from providing accurate and honest responses for fear of losing their jobs if someone were to

find out they were using drugs. A conclusion drawn from studies done by Rouse, Kozel, and Richards is that self-reported data can be trusted if the individual feels that his privacy will be protected and that there is a valid reason for the study(Bray, 1995). Great attempts have been made to ensure the participants of their anonymity. Another limitation of the survey is that it, too, is cross-sectional vice longitudinal. Many of the people who were surveyed in 1980 are probably out of the service now. Thus the results of the surveys could be showing some self-selection of people when they join the military. They understand that the military tests for drug use with a zero tolerance policy. Those so inclined to continue to use drugs may not wish to enter the military.

III. LOGIT MODEL ESTIMATES

A. VARIABLE DEFINITIONS

Similar variables were defined in both the NHSDA data set and the DODWWS data set so that models with similar variables could be estimated from both data sets. All of the variables were binary. Table 2 provides definitions of the explanatory and dependent variables in the model.

Table 2 Variable Definitions Source(NHSDA & DODWWS models)

Variable	Definition
SINGLE	= 1 if the individual is currently divorced, separated, or single; = 0 if otherwise.
MARRIED	= 1 if the individual is married; = 0 if otherwise.
NOHSDG	= 1 if the individual has no high school diploma; = 0 if otherwise.
GED	= 1 if the individual has a high school diploma, but it is a GED/ Alternate Education Degree; = 0 if otherwise.
HSDG	= 1 if the individual has a traditional high school diploma or is currently in college; = 0 if otherwise.
SOMCOLL	= 1 if the individual has attended some college, but did not complete a degree; = 0 if otherwise.
COLLGRAD	= 1 if the individual has a college degree (A 4 year, more advanced or professional degree); = 0 if otherwise.
AGE1	= 1 if the individual is 18 or 19 years old; = 0 if otherwise.
AGE2	= 1 if the individual is between 20 and 25 years old; = 0 if otherwise.
AGE3	= 1 if the individual is between 26 and 34 years old; = 0 if otherwise.
AGE4	= 1 if the individual is between 35 and 50 years old; = 0 if otherwise.
WHITE	= 1 if the individual is white; = 0 if otherwise.
BLACK	= 1 if the individual is black; = 0 if otherwise.
HISPANIC	= 1 if the individual is Hispanic; = 0 if otherwise.
OTHRACE	= 1 if the individual does not fall into one of the other race/ethnic categories; = 0 if otherwise.
MALE	= 1 if the individual is a male; = 0 if otherwise.
FEMALE	= 1 if the individual is a female; = 0 if otherwise.
DRUG30	= 1 if the individual has used any illicit drugs during the past month; = 0 if otherwise.

B. ESTIMATES FROM THE NATIONAL HOUSEHOLD SURVEY ON DRUG ABUSE

1. Population

The National Household Survey on Drug Abuse, 1994-B version has a sample size of 17,809 respondents, consisting of individuals ages 12 and older. Individuals between the ages of 12 and 17 were deleted from this study. This was because the focus of the thesis was to predict drug use at local Navy commands. Navy personnel are over the age of 17. By eliminating the 12 to 17-year-old category, the sample will be more representative of the Navy personnel. People over the age of 50 also were eliminated, again because only a small portion of Navy personnel are over 50. Also, people in this age group are very unlikely to use drugs. After restricting the data, the respondents who remained are between the ages of 18 and 50. Observations were also deleted due to missing information for specific variables. The final sample size used for estimating the model was 12,090 observations.

2. Variable Definitions

All the variables used in this thesis were created as dummy(binary) variables. They were either a 1 if the event was true or if individuals were in that category, or 0 if it

was false or if individuals were not in that particular category. Age was categorized into three groups in part because it appears that behavior is fairly homogeneous within certain age groups.

One of the goals of the thesis was to be able to identify location of individuals and see if location was an important independent factor in predicting whether an individual uses drugs. The geographic variables provided in the NHSDA data set were broken down into two census groupings. The first grouping was the census region, which is a very broad category that breaks the United States into only four areas: Northeast, North Central, South and West. These were too broad to be useful. The second grouping provided was by census division, which breaks the country into only nine regions. The states in these regions were defined earlier. These regions are initially included in the model, even though the regions represented large geographic areas. After examining the results of the NHSDA model, it was determined that the geographic divisions were too broad to provide any useful information. The initial goal had been to identify specific locations such as a city, i.e., San Diego, and identify how location in this metropolitan area affected drug use. Another problem with

the attempt to use geographic location was, the DODWWS data set did not contain similar location variables. The Enlisted and Officer Master files identified specific cities, but urban location was not available in the NHSDA or the DODWWS surveys.

Another group of variables that provided interesting information were the 'work status' variables. These variables provided information about whether or not a person was working. Work status was categorized as full- or part-time work, homemaker, whether or not an individual had been laid off, or disabled. It appeared that the more time an individual had on his hands, the more likely he was to use drugs. However, the causal sequence was not investigated, because it is also likely that the drug use is a determinant of work status. These variables were omitted from the final model because all people in the Navy are employed full time.

3. Cross-Tabulations of Drug Use

Cross-tabulations between the model variables and whether a person used drugs in the past 30 days provides useful exploratory information. Table 3 provides the results of the cross-tabulations for the NHSDA data set. Individuals in the age category AGE1(ages 18-19) were the highest users of drugs, with a reported use rate of 17.82

percent. Individuals with a GED had the second highest reported use rate at 14.29 percent, followed very closely by singles and males at 14.19 percent and 14.15 percent respectively. People in the OTHRACE category had the lowest self-reported drug use of 5.12 percent. AGE4(ages 35-50) followed at 5.20 percent and married people were next at 5.53 percent.

Table 3 Numbers and Proportion of Respondents in the NHSDA Survey Reporting They Used Drugs in the Past 30 Days Source(NHSDA data)

Variable	Total Number of Respondents	Number Who Used Drugs	Percentage Who Used Drugs
SINGLE	6574	933	14.19 %
MARRIED	5481	303	5.53 %
NOHSDG	2923	370	12.66 %
GED	371	53	14.29 %
HSDG	4101	433	10.56 %
SOMCOLL	2673	243	9.09 %
COLLGRAD	1985	129	6.50 %
AGE1(age 18-19)	999	178	17.82 %
AGE2(age 20-25)	2707	371	13.71 %
AGE3(age 26-34)	5223	525	10.05 %
AGE4(age 35-50)	3214	167	5.20 %
WHITE	5915	663	11.21 %
BLACK	2711	331	12.21 %
HISPANIC	3224	232	7.20 %
OTHRACE	293	15	5.12 %
MALE	5215	738	14.15 %
FEMALE	6928	503	7.26 %

4. Model Specification and Hypothesized Signs

The following is the specification of the multivariate model:

DRUG30 = f(MARRIED, NOHSDG, GED, SOMCOLL, COLLGRAD, AGE1, AGE2, AGE4, BLACK, HISPANIC, OTHRACE, MALE).

The estimated coefficients in the model explain the relationship between that variable and the probability of drug use in the last 30 days. This specification was based on the literature review and the variables that were available in both the DODWWS file and the Enlisted and Officer files. Other variables may have yielded a model that fit better, but they could not have been used to predict drug use at the individual UIC level or Navy wide. The dependent variable DRUG30 was chosen because it provided information about drug use in the past 30 days. Two other drug use variables were available: drug use in the past year and whether the individual ever used drugs. The 30 day drug use variable was chosen because the Navy is concerned with current drug use, not past use and tests for current use. If a person used drugs when in high school, it would not have any effect on the results of the drug test being

conducted today. The base case for the model is a single white female, HSDG, between 26 and 34 years old.

The hypothesized signs for the variables in the model also were based on the literature review. Married persons have more family and other responsibilities and are expected to be less likely to use drugs. Individuals who fail to complete high school, NOHSDG or GED, would be more likely to use drugs. The rationale is that non-graduates have demonstrated an inability to complete a task, i.e., complete high school. Conversely, people who go to college, SOMCOLL or COLLGRAD, would be less likely to use drugs. These people are more highly educated and should recognize the harmful side-effects of drugs. Younger individuals are more likely to be drug users, especially those in categories AGE1 and AGE2 (18-25 years old). Older age groups should be less likely to use drugs, especially those in categories AGE3 and AGE4 (26-50 years old). Originally, it was hypothesized race would be an important predictor of drug use because minorities would be more likely to be exposed to an environment where drugs were readily available. Being in an area where gangs are very prevalent also will increase drug use because it is often a part of the gang. It was hypothesized that a person who was in the category OTHRACE

would be less likely to use drugs because of their cultural background. I felt that males would be more likely to use drugs than females, in part because males are more likely to take chances and to try different things.

5. Model Results

One problem that exists among the variables in the model is multicollinearity. For example, being single and young(AGE1) are positively correlated. Conversely, married and AGE1 are negatively correlated. Other variables were correlated simply due to the way they were constructed. Nonetheless, these variables were all important in the model and it was felt that the multicollinearity should not affect the predictive power of the model.

The model was run using two weighting structures, unweighted and weighted, using the weighting variable in the data file. Weights represent the inverse of the probability of selection into the sample. For example, if oversampling of blacks had occurred by a factor of 2, then the weight necessary to reverse this oversampling would be ½, assuming race was the only variable used in the selection process. Table 4 presents the estimated (β) coefficients, the standard errors, and the significance level of the unweighted model. Ten of the 12 variables were significant

as well as the intercept. Eight were significant at the 0.01 significance level; two were significant at the 0.05 level and one was significant at the 0.10 level.

Table 4 Logit Estimates of Drug Use Past 30 Days - NHSDA Unweighted Estimates
Source(NHSDA data)

Variable	β Coefficient	Standard Error
INTERCEPT	-2.0507 *	0.1098
MARRIED	-0.8585 *	0.0978
NOHSDG	0.3417 *	0.1014
GED	0.4288 **	0.2089
SOMCOLL	-0.0205	0.1107
COLLGRAD	-0.4020 *	0.1416
AGE1	0.3071 **	0.1282
AGE2	0.1635 ***	0.0984
AGE4	-0.5811 *	0.1223
BLACK	-0.1174	0.0979
HISPANIC	-0.6481 *	0.1070
OTHRACE	-1.5838 *	0.4613
MALE	0.7520 *	0.0806

Number of observations = 7296
Concordant ratio = 70.5%
* Significant at the .01 level
** Significant at the .05 level
*** Significant at the .10 level

Table 5 presents the β coefficients, the standard errors, and the significance level of the logit model using weighted data. The full logit results of both of the NHSDA models are in the Appendix. Ten of the variables were significant in the model as well as the intercept. Six were significant up to the 0.01 level, three were significant up to the 0.05 level, and one was significant at the 0.10 level.

Table 5 Logit Estimates of Drug Use Past 30 Days - NHSDA Weighted Estimates
Source(NHSDA data)

Variable	β Coefficient	Standard Error
INTERCEPT	-2.0880 *	0.1198 *
MARRIED	-0.9086 *	0.0953 *
NOHSDG	0.3649 *	0.1191 *
GED	0.5622 **	0.2342 **
SOMCOLL	-0.1048	0.1148
COLLGRAD	-0.2268 **	0.1196 **
AGE1	0.0834	0.1577
AGE2	0.2008 ***	0.1152 ***
AGE4	-0.3510 *	0.1039 *
BLACK	-0.2854 **	0.1291 **
HISPANIC	-0.6558 *	0.1556 *
OTHRACE	-1.9737 *	0.4385 *
MALE	0.6335 *	0.0855 *

Number of observations = 7296
Concordant ratio = 70.1%
* Significant at the .01 level
** Significant at the .05 level
*** Significant at the .10 level

The most significant variables for both the weighted and the unweighted models is the sex of the individual. The education level of an individual, specifically if the individual has a GED, is the next most important variable.

Other significant variables include the OTHRACE and HISPANIC variables. Individuals in these categories were less likely to use drugs.

Table 6 presents the hypothesized signs versus the actual estimated signs of the explanatory variables. In all but two cases, the estimated signs were in accord with the hypothesized sign. The two exceptions were two of the race variables - black and Hispanic. I predicted positive while the coefficients were negative. The black coefficient was not significant for the unweighted model but was significant at the 0.05 level for the weighted model. The Hispanic coefficient was significant at the 0.01 level for both the unweighted and the weighted models. Otherwise, the hypothesized relationships were as expected, which suggests the model will provide accurate predictions of drug use when applied to other samples. This prediction is done in Chapter IV.

Table 6 NHSDA Hypothesized Signs vs Actual Signs Source(NHSDA data)

Variable	Hypothesized Sign	Actual Sign Unweighted	Actual Sign Weighted
MARRIED	Negative	Negative *	Negative *
NOHSDG	Positive	Positive *	Positive *
GED	Positive	Positive **	Positive **
SOMCOLL	Negative	Negative	Negative
COLLGRAD	Negative	Negative *	Negative ***
AGE1	Positive	Positive **	Positive
AGE2	Positive	Positive ***	Positive ***
AGE4	Negative	Negative *	Negative *
BLACK	Positive	Negative	Negative **
HISPANIC	Positive	Negative *	Negative *
OTHRACE	Negative	Negative *	Negative *
MALE	Positive	Positive *	Positive *

* Significant at the .01 level
** Significant at the .05 level
*** Significant at the .10 level

6. Marginal Effects

The marginal effects of a variable reveal how much more likely a person is to use drugs if they posses a given attribute (such as age). The marginal effects are created by creating a 'notional' person. The notional person is someone who has all of the characteristics of the base case, which in this model is a single, white female with an HSDG

who is between 26 and 34 years old. The probability of drug use for the notional person is 0.11398. Table 5 presents the marginal effects for the NHSDA model. The marginal effect is calculated by subtracting the predicted probability of drug use for the notional person from the predicted probability of drug use associated with a specific attribute (e.g., being married). For example,

Probability MARRIED - Probability Notional = Marginal Effect

Marginal Effect MARRIED = 0.05170 - 0.11398 = -0.06228

This value is multiplied by 100 and displayed in column 3 of Table 7. If a person is MARRIED, the probability of drug use is 6.23 percentage points lower than for the notional person who is otherwise the same except for being unmarried.

Table 7 Marginal Effects Calculated from the NHSDA Model Source(NHSDA data)

Variable	Predicted Probability	Marginal Effect*
MARRIED	0.05170	-6.228
NOHSDG	0.15329	3.931
GED	0.16494	5.096
SOMCOLL	0.11193	-0.205
COLLGRAD	0.07924	-3.474
AGE1	0.14885	3.487
AGE2	0.13156	1.758
AGE4	0.06712	-4.686
BLACK	0.10265	-1.133
HISPANIC	0.06304	-5.094
OTHRACE	0.02572	-8.826
MALE	0.21439	10.041
Base Case/Notional Person	0.11398	- -

* Marginal effect represents the percentage point difference between the base case and the case when this attribute = 1.

The table shows that the relative effect is largest for males, whose drug use probability is 10 points higher than for the notional person. The relative effect of a person who has a GED is slightly over 5 points higher than the notional person. The relative effect of a person that is OTHRACE is over 8 points lower than the notional person and the relative effect of a person that is HISPANIC is more

than 5 points lower than the notional person.

C. ESTIMATES FROM THE 1995 DEPARTMENT OF DEFENSE SURVEY OF HEALTH RELATED BEHAVIORS AMONG MILITARY PERSONNEL

1. Population

The 1995 Department of Defense Survey of Health Related Behaviors Among Military Personnel (DODWWS) surveyed 16,193 active duty military personnel. For this thesis, survey respondents were restricted to only Navy personnel. To be consistent with the NHSDA , the age range was also restricted to people between the ages of 18 and 50. If the answer to a question had multiple responses or was missing, that observation was omitted in the development of that variable. For example, if an individual indicated he had no high school degree and had a GED and had an HSDG, then that observation was omitted when establishing who had an HSDG, a GED and NOHSDG. After restricting the data, the final sample size for analysis was 4,227.

2. Variable Definitions

The variables defined were again created as dummy variables. They were coded as 1 if the event was true or if individuals were in that category or 0 if it was false or individuals were not in that category. The age variables were categorized in the same manner as the NHSDA variables. All other variables were also created so they would have the

same meaning as the NHSDA variables.

The location variables in the DODWWS were different than the NHSDA. The DODWWS variables were only defined in three categories: CONUS; CONUS, Afloat; OCONUS(Out of CONUS). Since these variables were very broad and could not be well related to the NHSDA variables, they were not used.

3. Cross-Tabulations of Drug Use

Cross-tabulations for the entire DODWWS were examined for preliminary information about the relationship between demographic variables and drug use. Table 8 provides the results of the cross-tabulations for the data set. Individuals in the age category AGE1(18-19 years old) had the highest self-reported drug use at 7.73 percent. Individuals with a GED had the second highest drug use rate at 5.66 percent. People in AGE4(35-50 years old) had the lowest self-reported drug use of 1.08 percent with people in the COLLGRAD(college graduates) category following close behind with only 1.24 percent.

Table 8 Numbers and Proportion of Respondents in DODWWS Survey Reporting They Used Drugs in the Past 30 Days Source(DODWWS data)

Variable	Total Number of Respondents	Number Who Used Drugs	Percentage Who Used Drugs
SINGLE	1417	67	4.73 %
MARRIED	2787	50	1.79 %
NOHSDG	33	1	3.03 %
GED	159	9	5.66 %
HSDG	1410	53	3.76 %
SOMCOLL	1654	42	2.54 %
COLLGRAD	969	12	1.24 %
AGE1(age 18-19)	194	15	7.73 %
AGE2(age 20-25)	1032	52	5.04 %
AGE3(age 26-34)	1232	31	2.52 %
AGE4(age(35-50)	1767	19	1.08 %
WHITE	2975	79	2.66 %
BLACK	558	15	2.69 %
HISPANIC	298	14	4.70 %
OTHRACE	394	9	2.28 %
MALE	3366	88	2.61 %
FEMALE	859	29	3.38 %

4. Model Specification and Hypothesized Signs

The following is the specification of the multivariate model:

DRUG30 = f(MARRIED, NOHSDG, GED, SOMCOLL, COLLGRAD, AGE1, AGE2, AGE4, BLACK, HISPANIC, OTHRACE, MALE).

This is the same specification as that of the NHSDA model. By using the same model, the results could be compared from one data set to the other. It also permits comparing the results of the NHSDA model on the DODWWS data and the DODWWS model on the NHSDA data. By estimating a similar logit model on the DODWWS survey, the variables that contribute to drug use at the local command under the current policy can be identified. It also allowed comparison for predicting drug use at specific commands. The base case for the DODWWS model is a single, white, female, HSDG, between 26 and 34 years old.

The hypothesized signs for the variables in the DODWWS model were also based upon the literature review. Married persons have more family and other responsibilities and are expected to be less likely to use drugs. Individuals who fail to complete high school, NOHSDG or GED, would be more

likely to use drugs. Those people who have not completed a traditional high school diploma may be less educated about the harmful effects of drugs. Conversely, people who went to college, SOMCOLL and COLLGRAD, would be less likely to use drugs. They should be more responsible and understand the effects of drug use. Younger individuals are more likely to be drug users, those in categories AGE1 and AGE2 (18-25 years old). Since these individuals are more willing to experiment with new and different things. Older age groups should be less likely to use drugs, especially those in categories AGE3 and AGE4 (26-50 years old). These people have more responsibilities and should know the outcome of using drugs. Also, people in this group who are in the military have made it through previous years of drug testing without being detected. I felt the race of an individual would not matter in the military. I felt that males would be more likely to use drugs than females. Since there are more males in the military than females, I felt males would have a greater likelihood of being exposed to drugs and people using drugs in the Navy than females.

5. Model Results

As with the NHSDA model, the variables in this model also exhibit multicollinearity. For example, being single and young(AGE1) are positively correlated. Conversely, MARRIED and AGE1 are negatively correlated. Other variables were correlated due to the way they were constructed. Nonetheless, these variables were all important in the model and it was felt that the multicollinearity would not affect the predictive power of the model.

The model was run using two different weighting structures, unweighted and weighted, using the weighting variable in the data file. Weights represented the inverse of the probability of selection into the sample. For example, if oversampling of blacks had occurred by a factor of 2, the weight necessary to reverse this oversampling effect would be ½, assuming race was the only variable used in the selection process. Table 9 presents the estimated (β) coefficients, the standard errors, and the significance level of the unweighted model. The full logit results of both of the DODWWS models are in the Appendix. Four of the variables were significant including the intercept. One was significant at the 0.01 level; the remaining three were significant at the 0.05 level.

Table 9 Logit Estimates of Drug Use Past 30 Days - DODWWS Unweighted Estimates
Source(DODWWS data)

Variable	β Coefficient	Standard Error
INTERCEPT	-3.0423 *	0.3514
MARRIED	-0.5046 **	0.2268
NOHSDG	-0.1350	1.0329
GED	0.8968 **	0.4121
SOMCOLL	-0.2278	0.2411
COLLGRAD	-0.4876	0.3566
AGE1	0.7073 **	0.3835
AGE2	0.3390	0.2677
AGE4	-0.7847 *	0.3062
BLACK	-0.1773	0.3035
HISPANIC	0.2867	0.3254
OTHRACE	-0.0466	0.3809
MALE	-0.0826	0.2356

Number of observations = 3802
Concordant ratio = 69.3%
* Significant at the .01 level
** Significant at the .05 level

Table 10 presents the β coefficients, the standard errors, and the significance level of the variables in the logit model using weighted data. Two of the variables were significant including the intercept. They were both significant at the 0.01 level.

Table 10 Logit Estimates of Drug Use Past 30 Days - DODWWS Weighted Estimates
Source(DODWWS data)

Variable	β Coefficient	Standard Error
INTERCEPT	-2.7968 *	0.3323
MARRIED	-0.6916 *	0.1912
NOHSDG	-0.2434	0.8800
GED	0.9659 *	0.3364
SOMCOLL	-0.2360	0.2061
COLLGRAD	-0.4402	0.3222
AGE1	0.5141	0.3324
AGE2	0.0993	0.2172
AGE4	-0.2971	0.2743
BLACK	0.0347	0.2393
HISPANIC	-0.1199	0.3172
OTHRACE	0.2284	0.2884
MALE	-0.0919	0.2566

Number of observations = 3802
Concordant ratio = 69.3%
* Significant at the .01 level

The most significant variable for predicting drug use is the education level of an individual, specifically if the individual has a GED. The next most important is the age of the individual, with younger individuals more likely to use drugs. If an individual is MARRIED or is a COLLGRAD they

are less likely to use drugs. The sex and race of an individual in the Navy does not have a significant impact on whether a person will use drugs.

Table 11 presents the hypothesized signs versus the actual signs. In all but two cases, the estimated signs accorded with the hypothesized sign. The two exceptions were NOHSDG and MALE. Positive coefficients were predicted, but insignificant negative coefficients were obtained. Otherwise, the hypothesized relationships were as expected, again suggesting the model would be reliable in predicting drug use.

Table 11 DODWWS Hypothesized Signs vs Actual Signs Source(DODWWS data)

Variable	Hypothesized Sign	Actual Sign Unweighted	Actual Sign Weighted
MARRIED	Negative	Negative **	Negative *
NOHSDG	Positive	Negative	Negative
GED	Positive	Positive **	Positive *
SOMCOLL	Negative	Negative	Negative
COLLGRAD	Negative	Negative	Negative
AGE1	Positive	Positive **	Positive
AGE2	Positive	Positive	Positive
AGE4	Negative	Negative *	Negative
BLACK	No effect	Negative	Positive
HISPANIC	No effect	Positive	Negative
OTHRACE	No effect	Negative	Positive
MALE	Positive	Negative	Negative

* Significant at the .01 level
** Significant at the .05 level

6. Marginal Effects

The marginal effects of a variable reveal how much more likely a person is to use drugs if they posses a given attribute (such as age). The marginal effects are created by creating a 'notional' person. The notional person is someone who has all of the characteristics of the base case. The base case for this model is a single, white female with

an HSDG who is between 26 and 34 years old. The probability of drug use for the notional person is .04555. Table 12 presents the marginal effects for the NHSDA model. The marginal effect is calculated by subtracting the predicted probability of drug use for the notional person from the predicted probability of drug use associated with a specific attribute, (e.g., being married). For example,

Probability MARRIED - Probability Notional = Marginal Effect

Marginal Effect MARRIED = 0.02801 - 0.04555 = -0.01754

This value is multiplied by 100 and displayed in column 3 of Table 10. If a person is MARRIED, the probability of drug use is 1.75 percentage points lower than the notional person.

Table 12 Marginal Effects Calculated from the DODWWS Model

Source(DODWWS data)

Variable	Predicted Probability	Marginal Effect*
MARRIED	0.02801	-1.754
NOHSDG	0.04003	-0.552
GED	0.10476	5.921
SOMCOLL	0.03661	-0.894
COLLGRAD	0.02847	-1.708
AGE1	0.08827	4.272
AGE2	0.06278	1.723
AGE4	0.02131	-2.424
BLACK	0.03843	-0.712
HISPANIC	0.05977	1.422
OTHRACE	0.04357	-0.198
MALE	0.04209	-0.346
Base Case/Notional Person	0.04555	- -

* Marginal effect represents the percentage point difference between the base case and the case when this attribute = 1.

The table shows that the relative effect is largest for an individual who has a GED, whose drug use probability is almost 6 points higher than the notional person. If a person is 18-19 years old(AGE1) then the probability of drug use is over 4 percentage points higher than the notional person. Individuals in age category AGE4(35-50 years old)

have a probability of drug use over 2 points lower than the notional person and for married personnel, the probability of drug use is almost 2 points lower than the notional person.

D. MODEL VALIDATION

Two techniques were used to validate the models. First, the goodness-of-fit of the model was assessed for each of the models, unweighted and weighted, and for each data set. Second, a random subset of observations were omitted from the analysis sample, the model was applied and the predictive power of the model was assessed by predicting the outcome for the omitted observations. Table 13 shows the goodness-of-fit of the NHSDA unweighted model. The goodness-of-fit is determined by creating a classification table of the dependent variable(DRUG30)vs the predicted variable(PREDICTS). The correct predictions are summed and divided by the total number of cases. Multiplying by 100 yields the percentage of observations correctly classified.

Table 13 NHSDA Model Goodness-of-Fit - Unweighted Data Source (NHSDA data)

	PREDICTS		
Actual DRUG30	No Drugs	Use Drugs	Total
No Drugs	6187	420	6607
Use Drugs	606	157	763
Total	6793	577	7370

PHAT ≥ 0.23
Goodness-of-fit = ((6187 + 157)/7370)(100) = 86.08%

Table 14 shows the goodness-of-fit for the NHSDA weighted model.

Table 14 NHSDA Model Goodness-of-Fit - Weighted Data Source (NHSDA data)

	PREDICT1		
Actual DRUG30	No Drugs	Use Drugs	Total
No Drugs	6381	226	6607
Use Drugs	680	83	763
Total	7061	309	7370

PHAT1 ≥ 0.22
Goodness-of-fit = ((6381 + 83)/7370)(100) = 87.71%

Both goodness-of-fit calculations for the NHSDA model show the models predict above 86 percent, which indicates a high level of accuracy. Table 15 shows the goodness of fit for the DODWWS unweighted model.

Table 15 DODWWS Model Goodness-of-Fit - Unweighted Data

Source (DODWWS data)

	PREDICTS		
Actual DRUG30	No Drugs	Use Drugs	Total
No Drugs	3670	27	3697
Use Drugs	103	2	105
Total	3773	29	3802

PHAT ≥ 0.10

Goodness-of-fit = ((3670 + 3)/3802)(100) = 96.61%

Table 16 shows the goodness-of-fit for the DODWWS weighted model.

Table 16 DODWWS Model Goodness-of-Fit - Weighted Data Source (DODWWS data)

	PREDICT1		
Actual DRUG30	No Drugs	Use Drugs	Total
No Drugs	3679	18	3697
Use Drugs	102	3	105
Total	3781	21	3802

PHAT1 ≥ 0.12

Goodness-of-fit = ((3679 + 3)/3802)(100) = 96.84

Both of the goodness-of-fit calculations for the DODWWS models show the models predict above 96 percent, which

indicates a very high level of accuracy. The models both appear to be very accurate in predicting the actual outcome.

In the second method, the NHSDA sample was split 60 percent to develop the model and 40 percent to validate the model. The DODWWS model was split 90 percent to develop the model and 10 percent to validate the model. The models were estimated on the 60 and 90 percent portions of the sample, then used to predict outcomes for the 40 and 10 percent, respectively. Both the NHSDA and the DODWWS models were run on each data set to determine their accuracy. The average prediction value from the models was compared to the actual self-reported drug use in the data set. Figure 5 shows the validation of the NHSDA model on the remaining 40 percent of the NHSDA data. The validation of the NHSDA model comes from the application of the NHSDA model compared to the actual self-reported drug use from the remaining 40 percent of the sample. The NHSDA unweighted model predicts 10.2 percent drug use, while the actual self-reported drug use is at 10.0 percent. Thus, this shows the model accurately predicted the overall rate of drug use. The weighted model predicted slightly above 9 percent.

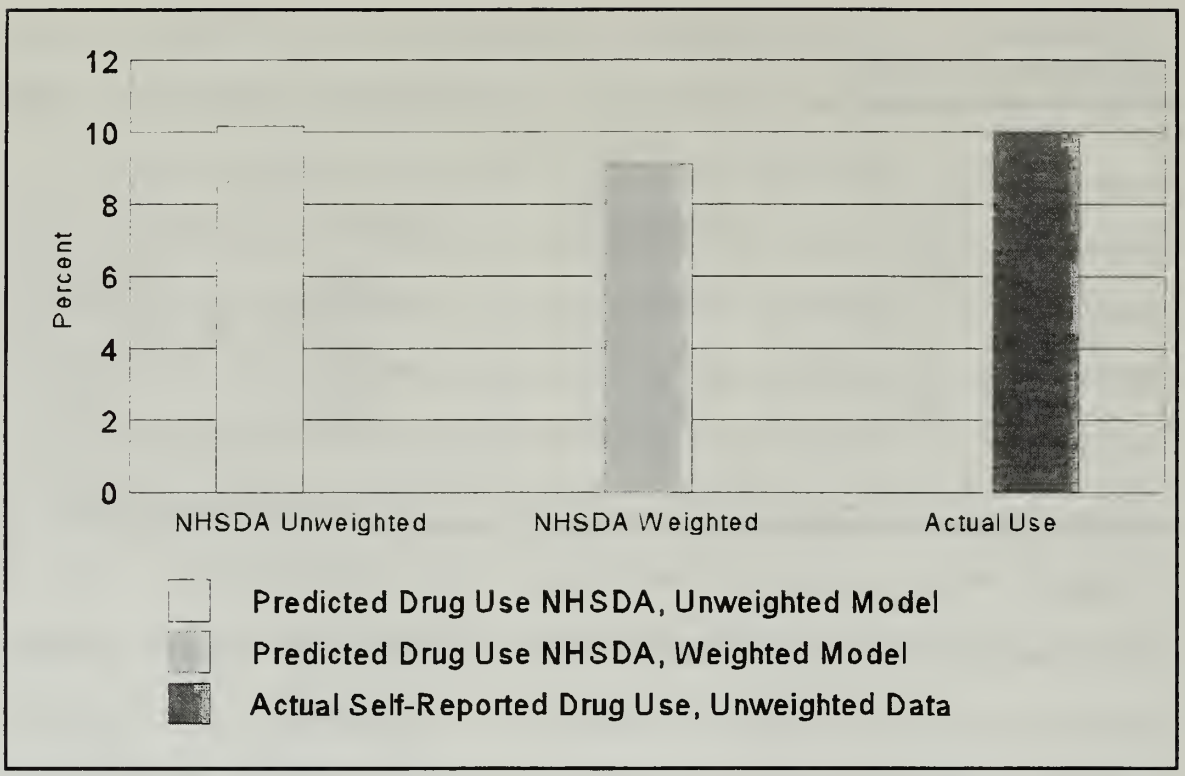

Figure 5 NHSDA Model Validation Source(NHSDA Data)

Figure 6 shows the validation of the DODWWS models on the remaining 10 percent of the DODWWS data set. The validation of the DODWWS model comes from the DODWWS model being compared to the actual self-reported drug use from the remaining 10 percent of the survey. The DODWWS unweighted model predicts about 2.9 percent while the actual self-reported drug use is 2.8 percent. This indicates the model accurately predicts overall drug use. The DODWWS weighted model predicts about 3.4 percent.

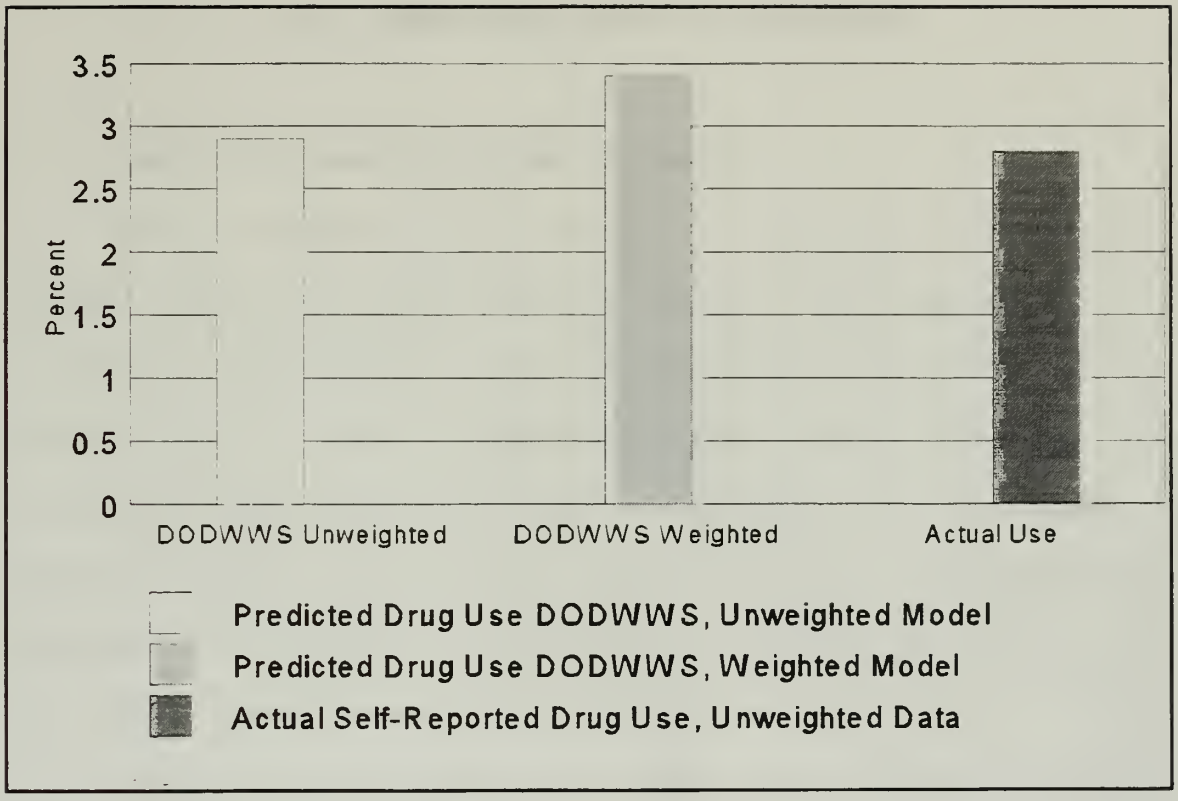

Figure 6 DODWWS Model Validation Source(DODWWS Data)

Note that the principal purpose of these models is not to predict whether an individual will use drugs, but rather what the overall drug use rate for a command might be.

IV. PREDICTING DRUG USE PATTERNS

A. PREDICTED DRUG USE RATES BY GROUP

Model estimates can be applied to specific demographic groups. The full logit results for all four models are listed in the Appendix. All of the groupings are broken down by sex and then a second attribute. The sex of an individual appeared to be highly significant in the NHSDA model in predicting drug use. The age of an individual also appeared to be highly significant in whether or not an individual used drugs.

The first demographic group analyzed is based on sex and age. Figure 7 shows the relationship between predicted drug use and age for males displayed as bar graphs. The graph shows that as age increases drug use decreases.

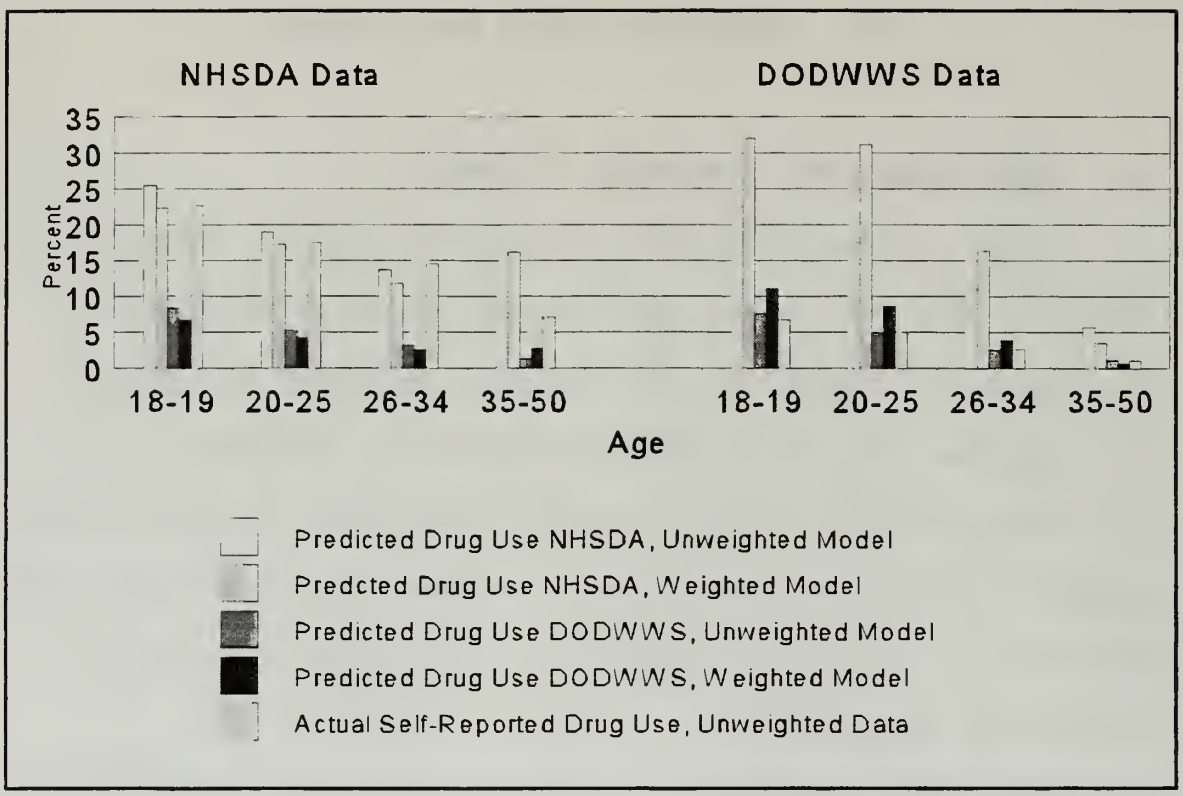

Figure 7 Male Drug Use by Age Source(NHSDA & DODWWS Data)

Table 17 shows the actual predicted drug use rates derived from the models estimated from the NHSDA and DODWWS surveys. These are the use rates displayed as bar graphs in Figure 7. Younger persons are the more likely to use drugs. For example, 18-19 year old males have a predicted drug use rate of 25.41 percent using the NHSDA unweighted model, whereas 35-50 year olds have a rate of only 7.02 percent. This is a difference of 18 points or a relative difference of 70 percent. The DODWWS model estimates what the drug use rate might be if the sample was under a constant threat of

drug testing. The trend it predicts is similar to the NHSDA models, though the overall rate is much lower due to the deterrence effect exerted by the Navy's drug testing program.

Table 17 Male Drug Use Rates (in percent) by Age Source(NHSDA & DODWWS Data)

NHSDA Data				
	Age 18-19	Age 20-25	Age 26-34	Age 35-50
Predicted Drug Use NHSDA Unweighted Model	25.41 %	18.96 %	13.67 %	7.02 %
Predicted Drug Use NHSDA Weighted Model	22.27 %	17.27 %	11.77 %	16.15 %
Predicted Drug Use DODWWS Unweighted Model	8.39 %	5.27 %	3.24 %	1.32 %
Predicted Drug Use DODWWS Weighted Model	6.73 %	4.30 %	2.57 %	2.76 %
Actual Self-Reported Drug Use Unweighted Data	22.7 %	17.50 %	14.50 %	7.10 %
DODWWS Data				
Predicted Drug Use NHSDA Unweighted Model	22.44 %	17.49 %	10.98 %	5.66 %
Predicted Drug Use NHSDA Weighted Model	32.03 %	31.11 %	16.35 %	3.56 %
Predicted Drug Use DODWWS Unweighted Model	7.70 %	4.80 %	2.61 %	1.13 %
Predicted Drug Use DODWWS Weighted Model	11.10 %	8.59 %	3.94 %	0.72 %
Actual Self-Reported Drug Use Unweighted Data	6.70 %	5.00 %	2.60 %	1.10 %

Figure 8 shows the relationship between drug use and age for females.

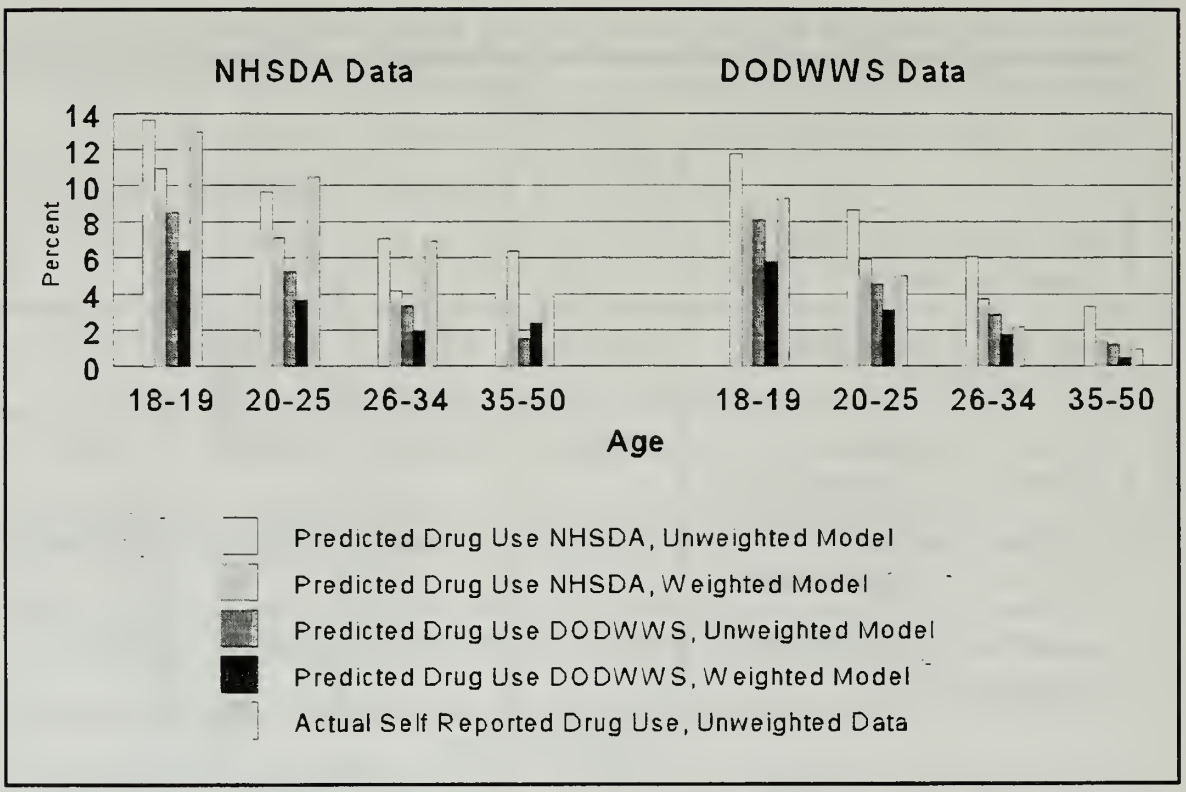

Figure 8 Female Drug Use by Age Source(NHSDA & DODWWS Data)

Table 18 shows the actual predicted drug use rates for the NHSDA and DODWWS data, which are displayed as bar graphs in Figure 8. A similar pattern occurs: as age increases, drug use decreases. For example, 18-19 year old females have a predicted drug use rate of 13.66 percent using the

NHSDA unweighted model. The lowest predicted rate is for the 35-50 year old group, 3.84 percent in the NHSDA unweighted model. The DODWWS model estimates the rate of drug use if the sample was under a constant threat of drug testing. The data exhibits a trend similar to the NHSDA models, but the overall rate is much lower.

Table 18 Female Drug Use Rates (in percent) by Age

Source(NHSDA & DODWWS Data)

NHSDA Data				
	Age 18-19	Age 20-25	Age 26-34	Age 35-50
Predicted Drug Use NHSDA Unweighted Model	13.66 %	9.65 %	7.06 %	3.84 %
Predicted Drug Use NHSDA Weighted Model	10.95 %	7.13 %	4.18 %	6.37 %
Predicted Drug Use DODWWS Unweighted Model	8.55 %	5.24 %	3.35 %	1.52 %
Predicted Drug Use DODWWS Weighted Model	6.40 %	3.64 %	1.93 %	2.37 %
Actual Self-Reported Drug Use Unweighted Data	13.00 %	10.50 %	6.90 %	3.90 %
DODWWS Data				
Predicted Drug Use NHSDA Unweighted Model	11.77 %	8.65 %	6.06 %	3.29 %
Predicted Drug Use NHSDA Weighted Model	8.29 %	5.92 %	3.73 %	1.34 %
Predicted Drug Use DODWWS Unweighted Model	8.10 %	4.57 %	2.84 %	1.21 %
Predicted Drug Use DODWWS Weighted Model	5.79 %	3.13 %	1.74 %	0.50 %
Actual Self-Reported Drug Use Unweighted Data	9.30 %	5.00 %	2.20 %	0.90 %

The second grouping examines drug use by education level and sex. Figure 9 shows predicted drug use by education for males.

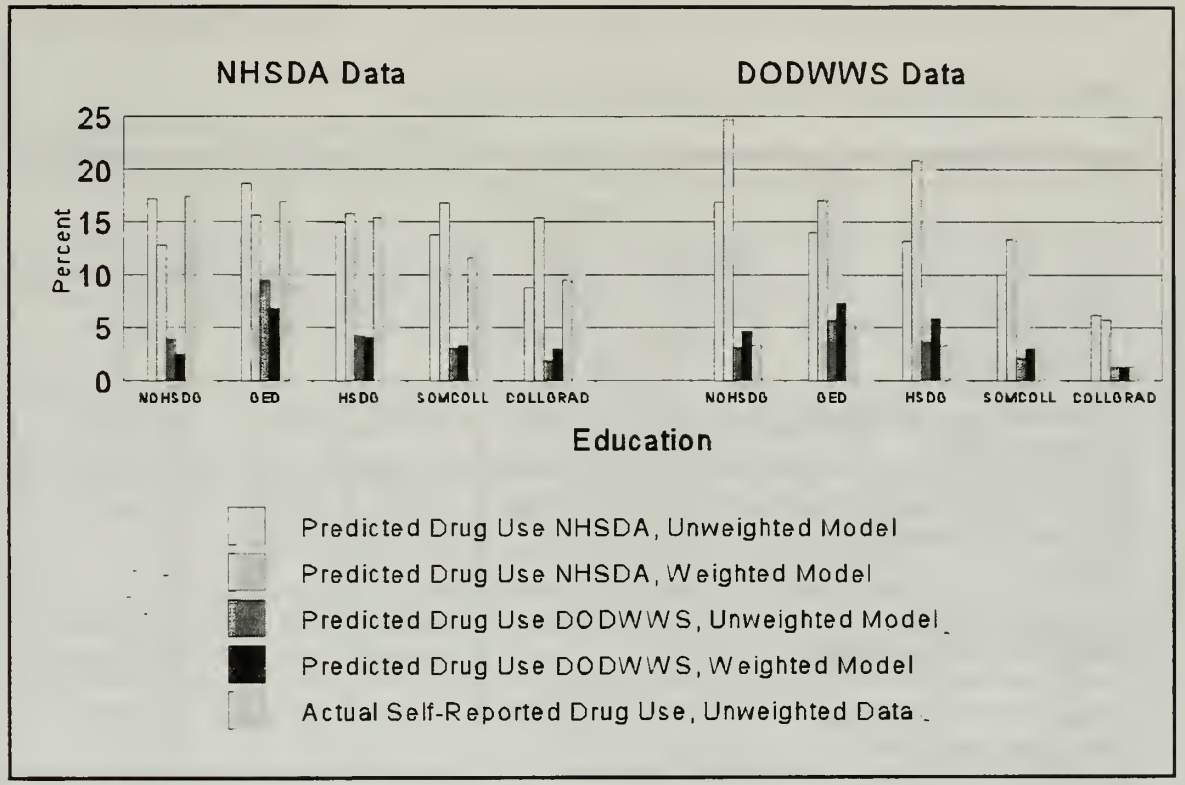

Figure 9 Male Drug Use by Education Source(NHSDA & DODWWS Data)

Table 19 shows the actual predicted drug use rates for the NHSDA and DODWWS data underlying the bar graphs in Figure 9. The less education the more likely to use drugs. For example in the NHSDA data, a male with a GED has a predicted drug use rate of 18.67 percent from the NHSDA model, as compared to a male college graduate with a predicted drug use rate of only 8.77 percent. Males in the

DODWWS with a GED have a predicted drug use rate of 13.98 percent from the DODWWS model, while similar college graduates are predicted to use drugs at a 6.17 percent rate. The NOHSDG category is not significant in the DODWWS data.

Table 19 Male Drug Use Rates (in percent) by Education

Source(NHSDA & DODWWS Data)

	NOHSDG	GED	HSDG	SOMCOLL	COLLGRAD
NHSDA Data					
Predicted Drug Use NHSDA Unweighted Model	17.12 %	18.67 %	14.96 %	13.80 %	8.77 %
Predicted Drug Use NHSDA Weighted Model	12.78 %	15.62 %	15.82 %	16.82 %	15.38 %
Predicted Drug Use DODWWS Unweighted Model	3.96 %	9.47 %	4.30 %	3.07 %	1.86 %
Predicted Drug Use DODWWS Weighted Model	2.51 %	6.79 %	4.08 %	3.28 %	2.98 %
Actual Self-Reported Drug Use Unweighted Data	17.40 %	16.90 %	15.40 %	11.60 %	9.50 %
DODWWS Data					
Predicted Drug Use NHSDA Unweighted Model	16.85 %	13.98 %	13.17 %	9.98 %	6.17 %
Predicted Drug Use NHSDA Weighted Model	24.72 %	17.02 %	20.81 %	13.36 %	5.75 %
Predicted Drug Use DODWWS Unweighted Model	3.10 %	5.68 %	3.66 %	2.10 %	1.30 %
Predicted Drug Use DODWWS Weighted Model	4.64 %	7.31 %	5.90 %	3.00 %	1.25 %
Actual Self-Reported Drug Use Unweighted Data	3.30 %	5.20 %	3.30 %	2.50 %	1.30 %

Figure 10 shows predicted drug use by education for females.

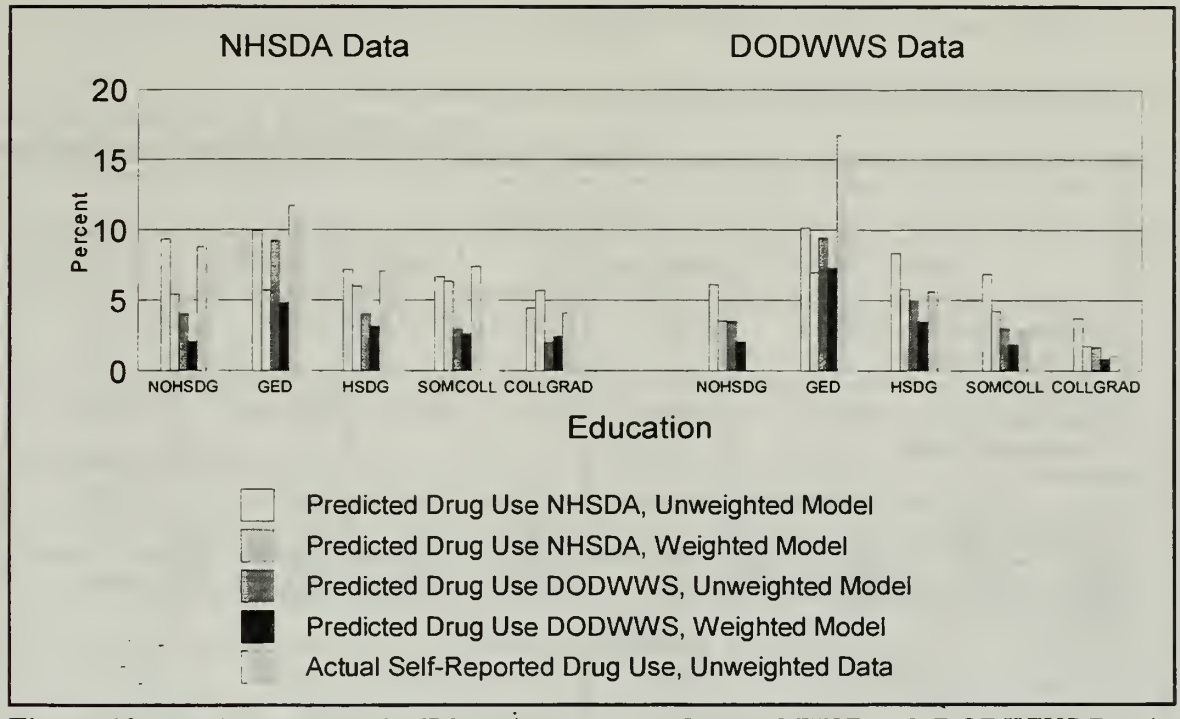

Figure 10 Female Drug Use by Education Source(NHSDA & DODWWS Data)

Table 20 shows the actual predicted drug use rates for the NHSDA and DODWWS data underlying the bar graphs in Figure 10. Once again, the less education an individual has the more likely to use drugs. For example, using the NHSDA data, a female with a GED has a predicted drug use rate of 9.94 percent for the NHSDA model, while a female that has graduated from college only has a predicted drug use rate of only 4.45 percent. A female in the DODWWS with a GED has a predicted drug use rate of 10.15 percent using the DODWWS

model, while a female college graduate has a predicted drug use rate of 3.74 percent. The NOHSDG category is not significant in the DODWWS data.

Table 20 Female Drug Use Rates (in percent) by Education

Source(NHSDA & DODWWS Data)

NHSDA Data					
	NOHSDG	GED	HSDG	SOMCOLL	COLLGRAD
Predicted Drug Use NHSDA Unweighted Model	9.35 %	9.94 %	7.17 %	6.69 %	4.45 %
Predicted Drug Use NHSDA Unweighted Model	5.41 %	5.70 %	6.03 %	6.35 %	5.69 %
Predicted Drug Use DODWWS Unweighted Model	4.03 %	9.22 %	4.06 %	3.00 %	2.03 %
Predicted Drug Use DODWWS Weighted Model	2.08 %	4.82 %	3.19 %	2.64 %	2.46 %
Actual Self-Reported Drug Use Unweighted Data	8.80 %	11.70 %	7.10 %	7.40 %	4.10 %
DODWWS Data					
Predicted Drug Use NHSDA Unweighted Model	6.11 %	10.15 %	8.39 %	6.85 %	3.74 %
Predicted Drug Use NHSDA Unweighted Model	3.56 %	6.98 %	5.80 %	4.23 %	1.77 %
Predicted Drug Use DODWWS Unweighted Model	3.52 %	9.45 %	5.01 %	3.04 %	1.69 %
Predicted Drug Use DODWWS Weighted Model	2.08 %	7.30 %	3.48 %	1.90 %	0.82 %
Actual Self-Reported Drug Use Unweighted Data	0.00 %	16.70 %	5.60 %	2.80 %	1.00 %

The third grouping examines predicted drug use across race and ethnic groups. Minority status appeared to have an influence on drug use in the NHSDA data but not in the DODWWS data. Figure 11 shows predicted drug use for males by race category.

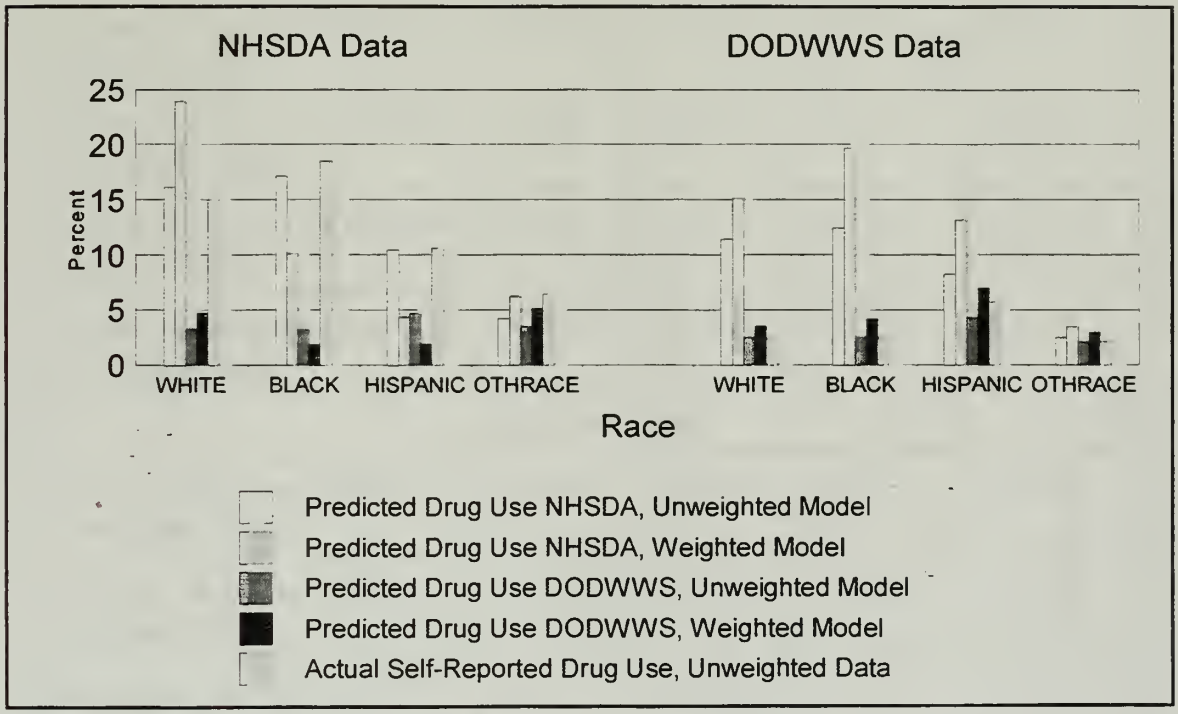

Figure 11 Male Drug Use by Race Source(NHSDA & DODWWS Data)

Table 21 shows the actual predicted drug use for males for the NHSDA and DODWWS data. In the NHSDA data, black males had the highest predicted drug use rates at 17.16 percent for the NHSDA unweighted model, while males of other races had the lowest predicted drug use rates at 4.20 percent. Using the DODWWS data, black males again had the

highest predicted drug use rates, 12.44 percent. The actual self-reported data had similar rates for whites, blacks and males of other races, with Hispanics having the highest self-reported rate of 5.70 percent.

Table 21 Male Drug Use Rates (in percent) by Race

Source(NHSDA & DODWWS Data)

NHSDA Data				
	WHITE	BLACK	HISPANIC	OTHRACE
Predicted Drug Use NHSDA Unweighted Model	16.12 %	17.16 %	10.40 %	4.20 %
Predicted Drug Use NHSDA Weighted Model	23.90 %	10.14 %	4.32 %	6.22 %
Predicted Drug Use DODWWS Unweighted Model	3.35 %	3.23 %	4.70 %	3.55 %
Predicted Drug Use DODWWS Weighted Model	4.78 %	1.88 %	1.92 %	5.15 %
Actual Self-Reported Drug Use Unweighted Data	15.00 %	18.50 %	10.60 %	6.40 %
DODWWS Data				
Predicted Drug Use NHSDA Unweighted Model	11.39 %	12.44 %	8.25 %	2.49 %
Predicted Drug Use NHSDA Weighted Model	15.12 %	19.69 %	13.19 %	3.49 %
Predicted Drug Use DODWWS Unweighted Model	2.52 %	2.58 %	4.35 %	2.10 %
Predicted Drug Use DODWWS Weighted Model	3.50 %	4.20 %	7.00 %	3.00 %
Actual Self-Reported Drug Use Unweighted Data	2.40 %	2.50 %	5.70 %	2.10 %

Figure 12 shows predicted drug use for females by race.

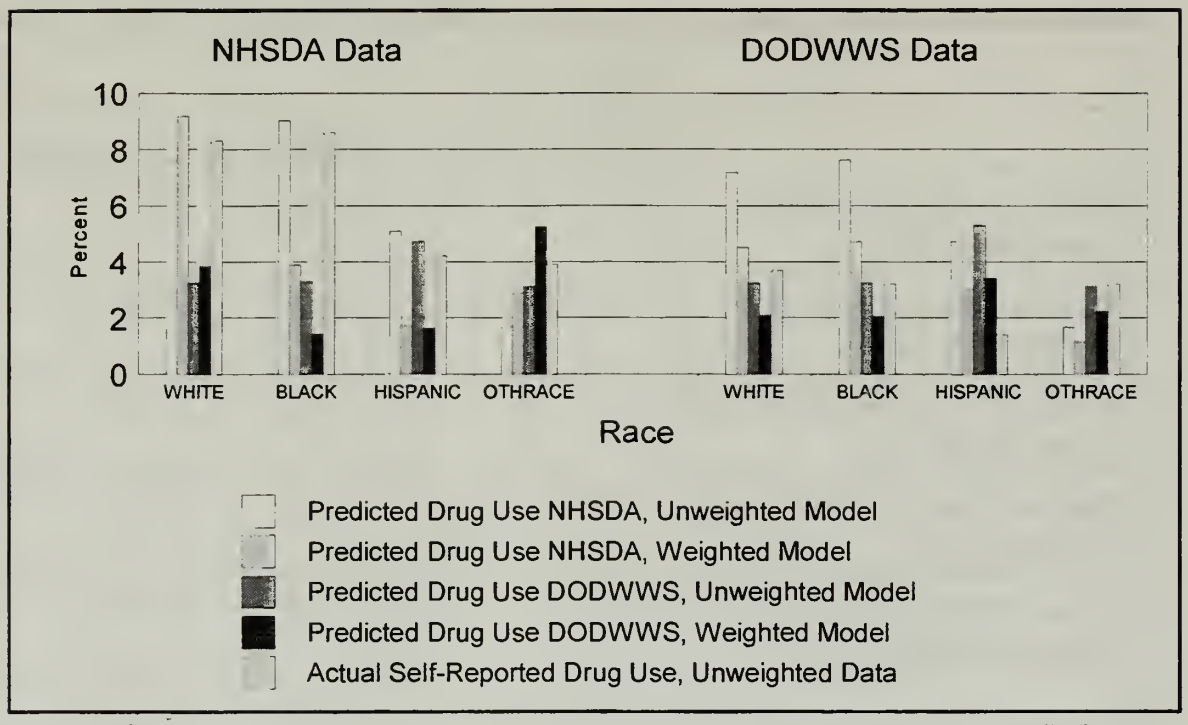

Figure 12 Female Drug Use by Race Source(NHSDA & DODWWS Data)

Table 22 shows the actual predicted drug use rates for females for the NHSDA and DODWWS data. With the NHSDA data, blacks had the highest predicted drug use rate at 9.02 percent using the NHSDA unweighted model, while other races had the lowest predicted drug use rate of 1.68 percent. Using the DODWWS data, the results of the NHSDA model were similar: blacks had the highest predicted drug use rate, 7.60 percent, while other races had the lowest, 1.66 percent. The self-reported data showed similar drug use rates for whites, blacks and other minorities, although

Hispanics had the lowest self-reported drug use rate, 1.40 percent.

Table 22 Female Drug Use Rates (in percent) by Race

Source(NHSDA & DODWWS Data)

NHSDA Data				
	WHITE	BLACK	HISPANIC	OTHRACE
Predicted Drug Use NHSDA Unweighted Model	7.60 %	9.02 %	5.09 %	1.68 %
Predicted Drug Use NHSDA Weighted Model	9.18 %	3.89 %	1.74 %	2.88 %
Predicted Drug Use DODWWS Unweighted Model	3.25 %	3.30 %	4.74 %	3.11 %
Predicted Drug Use DODWWS Weighted Model	3.86 %	1.42 %	1.63 %	5.24 %
Actual Self-Reported Drug Use Unweighted Data	8.30 %	8.60 %	4.20 %	3.90 %
DODWWS Data				
Predicted Drug Use NHSDA Unweighted Model	7.17 %	7.60 %	4.71 %	1.66 %
Predicted Drug Use NHSDA Weighted Model	4.52 %	4.71 %	3.03 %	1.15 %
Predicted Drug Use DODWWS Unweighted Model	3.27 %	3.25 %	5.29 %	3.13 %
Predicted Drug Use DODWWS Weighted Model	2.09 %	2.06 %	3.43 %	2.23 %
Actual Self-Reported Drug Use Unweighted Data	3.70 %	3.20 %	1.40 %	3.20 %

A fourth way to disaggregate the data is by geographic region. The DODWWS survey allowed the data to be broken into three very broad geographic regions: CONUS; CONUS, Afloat; and OCONUS(Out of CONUS). Examining these three regions may show if location plays a part in drug use (at least for very broad location variables). Figure 13 shows bar graphs of the predicted drug use rates by the three broad geographic locations in the DODWWS data.

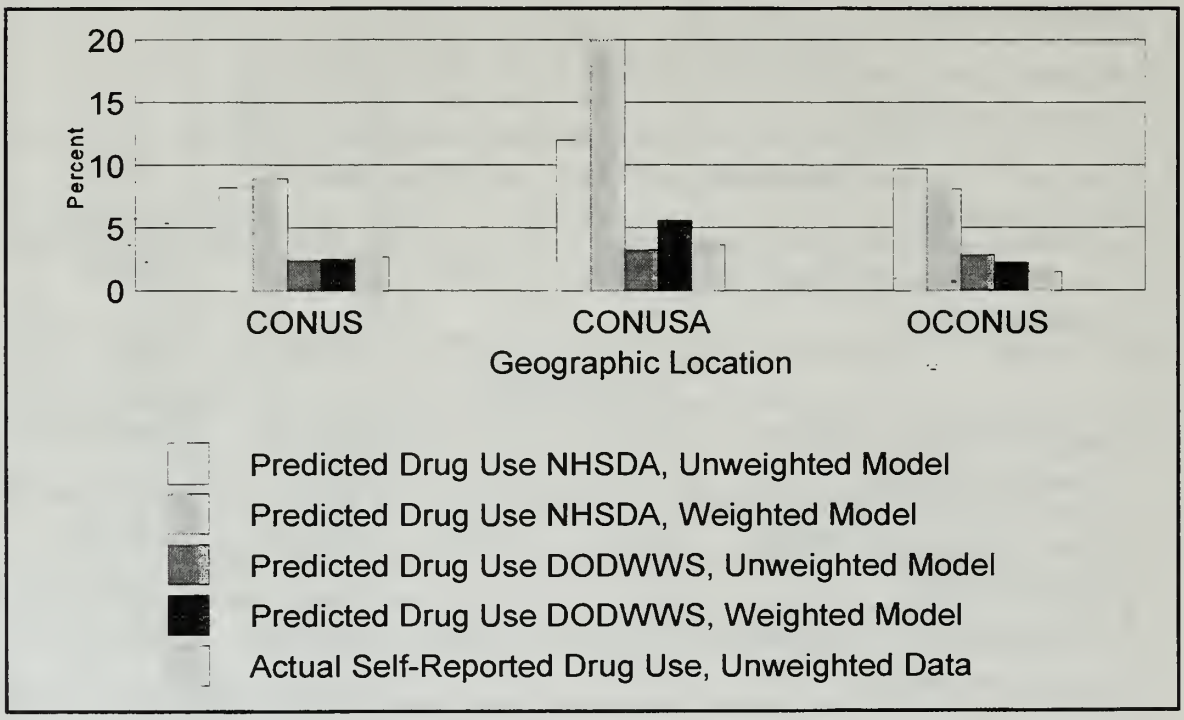

Figure 13 Drug Use by Geographic Location Source(DODWWS Data)

Table 23 shows the actual predicted drug use rates from the logit model for the DODWWS data. Drug use does not vary much between the three locations. Personnel located outside

of the United States have the lowest self-reported drug use rate of 1.5 percent. Military personnel stationed in the U.S. have a slightly lower predicted rate of about 8 percent compared to about 10 percent for people stationed abroad for the unweighted NHSDA model. Using the weighted NHSDA model, the order reverses: service members stationed abroad have a predicted rate of about 8 percent compared to about 9 percent for military members stationed in the U.S. Personnel stationed at afloat commands consistently have the highest predicted rates, about 12 percent from the unweighted NHSDA model and about 20 percent using the weighted.NHSDA model.

Table 23 Drug Use Rates (in percent) by Geographic Location Source(DODWWS Data)

	CONUS	CONUSA	OCONUS
Predicted Drug Use NHSDA Unweighted Model	8.20 %	11.95 %	9.70 %
Predicted Drug Use NHSDA Weighted Model	8.93 %	20.00 %	8.09 %
Predicted Drug Use DODWWS Unweighted Model	2.43 %	3.27 %	2.85 %
Predicted Drug Use DODWWS Weighted Model	2.52 %	5.57 %	2.27 %
Actual Self-Reported Drug Use Unweighted Data	2.70 %	3.60 %	1.50 %

B. CHARACTERISTICS OF THE NAVY AND LOCAL COMMANDS

In order to apply these models to local Navy commands, Enlisted and Officer files were obtained from the Defense Manpower Data Center(DMDC) in Monterey. These files are representative of the entire Navy at a certain point in time, specifically September 30, 1994 and September 30, 1995. Means for basic demographic variables for the entire Navy are presented in Table 24.

Table 24 Percent Distribution of Sample by Demographic Characteristics by Year -- Entire Navy Source(DMDC)

Variable	September 30, 1994	September 30, 1995
SINGLE	0.44	0.43
MARRIED	0.56	0.57
NOHSDG	0.02	0.02
GED	0.04	0.04
HSDG	0.79	0.79
SOMCOLL	0.02	0.02
COLLGRAD	0.13	0.14
AGE1(age 18-19)	0.08	0.07
AGE2(age 20-25)	0.37	0.36
AGE3(age 26-34)	0.39	0.40
AGE4(age 35-50)	0.21	0.22
WHITE	0.71	0.70
BLACK	0.16	0.17
HISPANIC	0.07	0.07
OTHRACE	0.06	0.06
MALE	0.89	0.88
FEMALE	0.11	0.12
Total Population	460,389	426,798

All personnel in the DMDC files are attached to a UIC. This allowed the personnel to be differentiated by UIC. The specific threat of drug use for a UIC could be examined based on the demographic characteristics of personnel stationed at that command(UIC).

Three UICs were selected to apply the logit models to for analysis. Only three UICs were selected in order to illustrate the feasibility of using the predicting technique. Also, the three UICs were selected to represent a variety of commands. The first UIC was selected because of its very large population: over 11,000 personnel in 1994. The second was picked because it was known to be a shore command. The third was picked because it was known to be a sea command. The first UIC was picked randomly, whereas the second two were subjectively selected because of the nature of the commands. Table 25 provides the demographic characteristics of these UICs.

As Table 25 shows, UIC 1 differs significantly from the all-Navy averages in Table 24. Specifically, UIC 1 has a far higher proportion of young, single, mostly non-college personnel than the Navy average. One can presume that these are mostly junior enlisted personnel. UIC 2, by contrast, has a higher proportion of older, married, college

graduates. Presumably, these are mostly mid-grade officers. UIC 3 has a demographic composition that is very close to the Navy wide composition.

Table 25 Percent Distribution of Sample by Demographic Characteristics by Year -- Three Selected UICs Source(DMDC)

	UIC 1		UIC 2		UIC 3	
Variable	1994	1995	1994	1995	1994	1995
SINGLE	0.97	0.97	0.25	0.24	0.47	0.50
MARRIED	0.03	0.03	0.75	0.76	0.53	.050
NOHSDG	0.01	0.01	0.00	0.00	0.04	0.02
GED	0.04	0.03	0.00	0.00	0.06	0.04
HSDG	0.93	0.95	0.00	0.00	0.80	0.86
SOMCOLL	0.01	0.01	0.00	0.00	0.02	0.01
COLLGRAD	0.01	0.01	1.00	1.00	0.08	0.07
AGE1(age 18-19)	0.73	0.76	0.00	0.00	0.07	0.06
AGE2(age 20-25)	0.24	0.21	0.01	0.00	0.42	0.47
AGE3(age 26-34)	0.03	0.03	0.81	0.83	0.42	0.38
AGE4(age 35-50)	0.00	0.00	0.19	0.17	0.15	0.13
WHITE	0.67	0.63	0.86	0.84	0.66	0.67
BLACK	0.19	0.20	0.06	0.07	0.26	0.27
HISPANIC	0.09	0.12	0.04	0.04	0.06	0.05
OTHRACE	0.04	0.05	0.04	0.05	0.02	0.02
MALE	0.92	0.83	0.88	0.88	1.00	1.00
FEMALE	0.08	0.17	0.12	0.12	0.00	0.00
Total Population	11,560	10,459	1,256	1,110	222	209

C. DRUG USE PREDICTIONS

The estimated parameters obtained from the NHSDA and DODWWS models may be applied to the three UICs using the demographic data available in the Enlisted and Officer files obtained from DMDC. The unweighted models appeared to have better predictive power than the weighted models, so only the unweighted models were applied to the DMDC files. The models developed using the NHSDA and DODWWS surveys can be used to predict drug use at the individual command level, as well as for the entire Navy. Figure 14 displays a bar graph of the threat of drug use for the entire Navy based on the demographic composition in 1994 and 1995. Both the NHSDA and the DODWWS model are used to predict drug use. A predicted drug threat was determined for each individual, then the data was aggregated to form a predicted threat to the entire Navy.

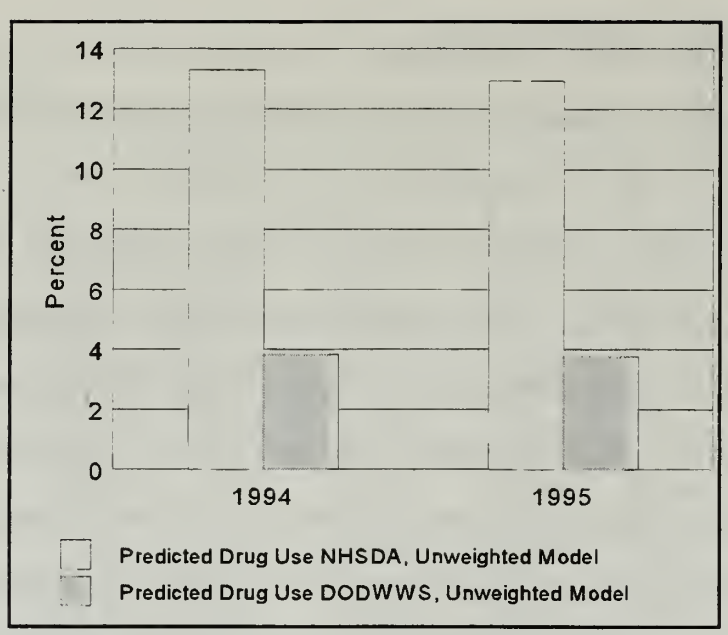

Figure 14 Predicted Drug Threat by Year -- Entire Navy Source(DMDC)

Table 26 shows the actual predicted drug use for the entire Navy. The predicted drug threat for the entire Navy is about 3.8 percent using the DODWWS model, while the NHSDA model predicts a higher threat of about 13 percent for the entire Navy.

Table 26 Predicted Drug Use Rates (in percent) by Year -- Entire Navy Source(DMDC)

Variable	1994	1995
Predicted Drug Use NHSDA Unweighted Model	13.29 %	12.92 %
Predicted Drug Use DODWWS Unweighted Model	3.84 %	3.77 %

Figure 15 shows a bar graph of the predicted threat of drug use at the three UICs for 1994 and 1995 using models estimated from both the NHSDA and DODWWS data.

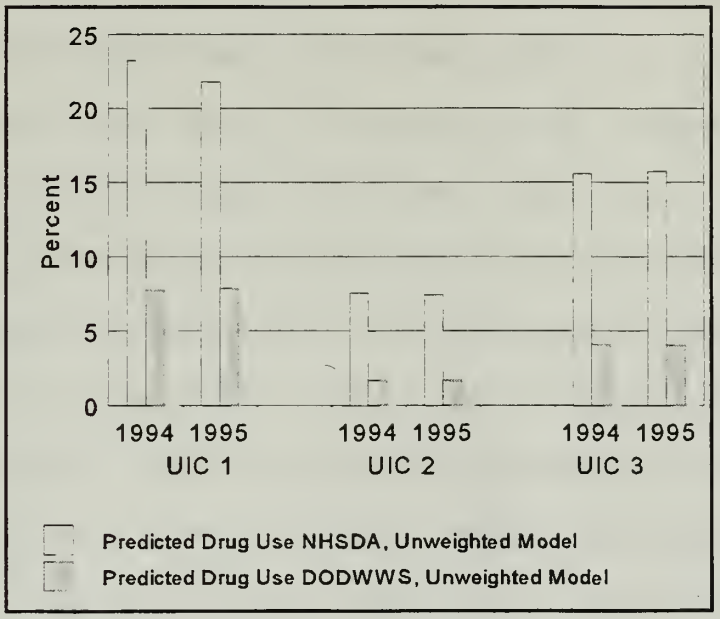

Figure 15 Predicted Drug Threat by Year -- Three Selected UICs Source(DMDC)

Table 27 shows the actual predicted drug use for the individual UICs. The NHSDA model predicts a drug threat of over 22 percent for UIC 1, about 7.5 percent for UIC 2 and 15.5 percent for UIC 3. The DODWWS model predicts a drug threat of about 7.8 percent for UIC 1, about 1.7 percent for UIC 2, and over 4 percent for UIC 3. There is a considerable difference of predicted drug threat between the

three local commands and it is based entirely on differences in their demographic characteristics. UIC 1 and UIC 3 have a far higher proportion of non-college educated personnel(enlisted), then UIC 2. UIC 2 consists entirely of college graduates(officers). UIC 1 and UIC 3 also have a significant number of personnel who have not completed high school. UIC 1 is almost entirely single, while UIC 3 is split evenly between married and single personnel, and UIC 2 is predominantly married. UIC 1 personnel are mainly younger, with the majority in the 18-19 year old range. In contrast, UIC 2 personnel are mainly older, with the majority in the 26-34 year old range, while the majority of UIC 3 personnel are in the 20-34 year old range. All three UICs are mainly males, however UIC 2 has the highest percentage of females, and UIC 3 has the lowest percentage.

Table 27 Predicted Drug Use Rates (in percent) by Year -- Three Selected UICs
Source(DMDC)

	UIC 1		UIC 2		UIC 3	
Variable	1994	1995	1994	1995	1994	1995
Predicted Drug Use NHSDA Unweighted Model	23.25 %	21.80 %	7.55 %	7.44 %	15.56 %	15.73 %
Predicted Drug Use DODWWS Unweighted Model	7.78 %	7.88 %	1.71 %	1.71 %	4.12 %	4.04 %

Thus, the model predicts widely varying drug use among the three commands; it predicts that the underlying threat of drug use (if there were no drug testing) as derived from NHSDA data, and the actual rate of drug use (derived from DODWWS data) should vary considerably.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The primary research question posed by this thesis was the following: Can a model be developed that predicts potential drug use among personnel at specific local Navy commands? The secondary questions posed were the following: Can demographic characteristics be used to predict potential drug users? Can the characteristics of civilian drug users be applied to the population of military personnel? Can drug use predictors be developed for specific geographic locations? This thesis shows that the threat of drug use can be predicted with a high degree of accuracy.

A model was estimated using civilian data and applied to military personnel. In particular, the threat of drug use in the military was predicted from a model estimated that used NHSDA civilian data. The predictions were based on a civilian population that does not have a threat of drug testing. The sex of an individual in the civilian society is the most significant factor in drug use. A male is more than 10 percentage points more likely to use drugs. A person with a GED is over 5 percentage points more likely to use drugs. If a person is between 34 and 50 years old they

are almost 5 percentage points less likely to use drugs. If a person is married then they are more than 6 percentage points less likely to use drugs. The results of the NHSDA may be applied to a military population to give local commanders an estimate of what the underlying threat is to their command for drug use. This will help the commander determine an appropriate level of urinalysis testing.

The predicting model assumes that, in the absence of drug testing, the drug use rate would be identical to that in the civilian youth population. In actuality, the military represents a selected sample: applicants must meet certain eligibility standards, which are likely to restrict entry to population segments with high drug propensities. Military members are also self-selected and those with a high 'taste' for the military, again, are not as likely to be as drug prone as other youth. Unfortunately, while civilian drug use patterns are likely to overstate these among service members, the size of the bias is unknown.

The DODWWS model also yields valuable results. Variables that were significant in the DODWWS model were also significant in the NHSDA model. The most significant factor for determining drug use for the military population is possession of a GED. An individual with a GED is almost

6 percentage points more likely to use drugs than the base case person who is a high school diploma graduate. Individuals between 18 and 19 years old are over 4 percentage points more likely to use drugs than the base case person who is between 26 and 34 years old. Whereas, a person between 34 and 50 is over 4 percentage points less likely to use drugs than the base case person who is between 26 and 34 years old. Married personnel are almost 2 percentage points less likely to use drugs than the base case person who is single. However, the sex and race of an individual are found not significantly related to predicting drug use in the military population.

Demographic characteristics can be used to predict the threat of drug use. The two models were developed from different data sources, yet both yielded accurate predictors. In particular, the NHSDA model predicted overall use of 10.2 percent for a collection of personnel whose actual rate of use was 10 percent. This confirms that use of demographic attributes can be used to predict overall drug use.

Specific geographic location can be applied to aid in prediction of the threat of drug use. However, the DODWWS survey had removed the respondent's location to protect

privacy. The NHSDA geographic location variables that were available also were not useful due to their highly aggregated nature. The broad DODWWS location variables indicated slight differences in drug use by region. The hope was to be able to add location to the demographic variables in order to improve prediction accuracy at specific locations. It would be valuable to add more specific geographic locations to the DODWWS data file to permit the use of geographic data.

B. RECOMMENDATIONS

It is recommended that a decision support system based upon the methodology and models developed in this thesis be developed for use by local commanders. The system could be used as an input to the determination of an appropriate local command drug testing program.

A higher threat would indicate that a higher testing rate would be appropriate while a lower threat should result in a lower testing rate. The overall amount of testing required in the Navy to achieve a given level of effectiveness would likely decrease overall, since testing rates would be based on the threat and targeted towards higher risk commands. The deterrence effect of drug testing would not be eliminated at any command, however, because the

local commands would still be conducting random urinalysis at some level of testing. Total benefits should rise because testing would increase where the threat is greatest and fall where it is the lowest.

It is also recommended that the geographic data eliminated from the DODWWS data file be available for analysis. Geographic location could then be used to improve the model's ability to predict the local area drug use threat more accurately. The local commander could then have a model tailored to the specific geographic location of his/her command. This would allow testing rates to be refined with even greater precision.

The model should also be updated regularly. For example, the logit parameters should be run on the 1995 NHSDA survey data. The predicted drug use should be compared to the actual self-reported drug use to determine the model accuracy. This would determine if any of the characteristics developed in the model had changed. It is imperative that local commanders be made aware of the potential level of drug use in their organizations, since they are in the forefront of Navy readiness.

Table A1. NHSDA Unweighted Model

Response Profile

Ordered Value	DRUG30	Count
1	1=DRGS LST MONTH	754
2	0=NO DRUGS LST MN	6542

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	4851.937	4483.358	.
SC	4858.833	4572.994	.
-2 LOG L	4849.937	4457.358	392.580 with 12 DF (p=0.0001)
Score	.	.	376.020 with 12 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCEPT	1	-2.0507	0.1098	348.5258	0.0001	.	0.129
MARRIED	1	-0.8585	0.0978	77.0455	0.0001	-0.235529	0.424
NOHSDG	1	0.3417	0.1014	11.3526	0.0008	0.080938	1.407
GED	1	0.4288	0.2089	4.2127	0.0401	0.040342	1.535
SOMCOLL	1	-0.0205	0.1107	0.0342	0.8532	-0.004702	0.980
COLLGRAD	1	-0.4020	0.1416	8.0591	0.0045	-0.081983	0.669
AGE1	1	0.3071	0.1282	5.7403	0.0166	0.046897	1.359
AGE2	1	0.1635	0.0984	2.7615	0.0966	0.037448	1.178
AGE4	1	-0.5811	0.1223	22.5820	0.0001	-0.141095	0.559
BLACK	1	-0.1174	0.0979	1.4386	0.2304	-0.027002	0.889
HISPANIC	1	-0.6481	0.1070	36.7115	0.0001	-0.157488	0.523
OTHRACE	1	-1.5838	0.4613	11.7884	0.0006	-0.134727	0.205
MALE	1	0.7520	0.0806	87.1039	0.0001	0.205241	2.121

Association of Predicted Probabilities and Observed Responses

Concordant = 70.5%	Somers' D = 0.424
Discordant = 28.1%	Gamma = 0.430
Tied = 1.5%	Tau-a = 0.079
(4932668 pairs)	c = 0.712

Table A2. NHSDA Weighted Model

Response Profile

Ordered Value	DRUG30		Count	Total Weight
1	1	1=DRGS LST MONTH	754	665.5095
2	0	0=NO DRUGS LST MN	6542	7296.0000

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	4579.121	4263.355	.
SC	4586.016	4352.991	.
-2 LOG L	4577.121	4237.355	339.766 with 12 DF (p=0.0001)
Score	.	.	333.558 with 12 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCEPT	1	-2.0080	0.1198	303.8380	0.0001	.	0.124
MARRIED	1	-0.9086	0.0953	90.9477	0.0001	-0.258615	0.403
NOHSDG	1	0.3649	0.1191	9.3916	0.0022	0.075513	1.440
GED	1	0.5622	0.2342	5.7650	0.0163	0.047758	1.755
SOMCOLL	1	-0.1048	0.1148	0.8337	0.3612	-0.025874	0.901
COLLGRAD	1	-0.2268	0.1196	3.5934	0.0580	-0.057114	0.797
AGE1	1	0.0834	0.1577	0.2800	0.5967	0.011376	1.087
AGE2	1	0.2008	0.1152	3.0397	0.0813	0.042780	1.222
AGE4	1	-0.3510	0.1039	11.4166	0.0007	-0.101007	0.704
BLACK	1	-0.2854	0.1291	4.8848	0.0271	-0.052901	0.752
HISPANIC	1	-0.6558	0.1556	17.7683	0.0001	-0.115586	0.519
OTHRACE	1	-1.9737	0.4385	20.2601	0.0001	-0.242840	0.139
MALE	1	0.6335	0.0855	54.9064	0.0001	0.182310	1.884

Association of Predicted Probabilities and Observed Responses

Concordant = 70.1%		Somers' D = 0.416	
Discordant = 28.5%		Gamma = 0.422	
Tied = 1.5%		Tau-a = 0.077	
(4932668 pairs)		c = 0.708	

Table A3. DODWWS Unweighted Model

Response Profile

Ordered Value	DRUG30		Count
1	1=DRGS LST MONTH		105
2	0=NO DRUGS LST MN		3697

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	962.831	929.658	.
SC	969.074	1010.821	.
-2 LOG L	960.831	903.658	57.173 with 12 DF (p=0.0001)
Score	.	.	61.686 with 12 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCEPT	1	-3.0423	0.3514	74.9722	0.0001	.	0.048
MARRIED	1	-0.5046	0.2268	4.9512	0.0261	-0.131370	0.604
NOHSDG	1	-0.1350	1.0329	0.0171	0.8960	-0.006694	0.874
GED	1	0.8968	0.4121	4.7366	0.0295	0.091840	2.452
SOMCOLL	1	-0.2278	0.2411	0.8924	0.3448	-0.061321	0.796
COLLGRAD	1	-0.4876	0.3566	1.8696	0.1715	-0.113038	0.614
AGE1	1	0.7073	0.3835	3.4023	0.0651	0.082610	2.029
AGE2	1	0.3390	0.2677	1.6037	0.2054	0.080432	1.404
AGE4	1	-0.7847	0.3062	6.5668	0.0104	-0.213554	0.456
BLACK	1	-0.1773	0.30335	0.3414	0.5590	-0.033017	0.838
HISPANIC	1	0.2867	0.3254	0.7763	0.3783	0.040187	1.332
OTHRACE	1	-0.0466	0.3809	0.0150	0.9026	-0.007500	0.954
MALE	1	-0.0826	0.23556	0.1230	0.7258	-0.018450	0.921

Association of Predicted Probabilities and Observed Responses

Concordant = 69.3%	Somers' D = 0.421
Discordant = 27.2%	Gamma = 0.436
Tied = 3.5%	Tau-a = 0.023
(388185 pairs)	c = 0.711

Table A4. DODWWS Weighted Model

Response Profile

Ordered Value	DRUG30		Count	Total Weight
1	1	1=DRGS LST MONTH	105	143.2240
2	0	0=NO DRUGS LST MN	3697	3802.0024

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1233.004	1212.711	.
SC	1239.247	1293.874	.
-2 LOG L	1231.004	1186.711	44.292 with 12 DF (p=0.0001)
Score	.	.	48.228 with 12 DF (p=0.0001)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCEPT	1	-2.7968	0.3238	70.8201	0.0001	.	0.061
MARRIED	1	-0.6916	0.1912	13.0787	0.0003	-0.189349	0.501
NOHSDG	1	-0.2434	0.8800	0.0765	0.7821	-0.014480	0.784
GED	1	0.9659	0.3364	8.2435	0.0041	0.102696	2.627
SOMCOLL	1	-0.2360	0.2061	1.3115	0.2521	-0.064271	0.790
COLLGRAD	1	-0.4402	0.3222	1.8666	0.1719	-0.092097	0.644
AGE1	1	0.5141	0.3324	2.3911	0.1220	0.064348	1.672
AGE2	1	0.0993	0.2172	0.2093	0.6474	0.026686	1.104
AGE4	1	-0.2971	0.2743	1.1728	0.2788	-0.071504	0.743
BLACK	1	-0.0347	0.2393	0.0210	0.8848	-0.007010	1.035
HISPANIC	1	-0.1199	0.3172	0.1428	0.7055	-0.018220	0.887
OTHRACE	1	0.2284	0.2884	0.6271	0.4284	0.037517	1.257
MALE	1	-0.0919	0.2566	0.1284	0.7201	-0.016453	0.912

Association of Predicted Probabilities and Observed Responses

Concordant = 66.8%	Somers' D = 0.378
Discordant = 29.0%	Gamma = 0.394
Tied = 4.2%	Tau-a = 0.020
(388185 pairs)	c = 0.689

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